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CONTENTS.

EDITORIAL: PAGE.
Paragraphs ... 189
ILLUSTRATED ARTICLES:
The Chicago & St. Louis Electric Railway ... 191
Utilization of Niagara Falls ... 193
Chronological History of Electricity—Part II., by P. F. Mottelay ... 195
The Storage Battery on the Stage ... 197
An Electric Street Sprinkler ... 197
The Union Electric Company's Launch ... 197
On a Magnetic Balance and its Practical Use, by Dr. H. E. J. G. Du Bois ... 198
Electro-Metallurgy—XIV., by F. M. F. Cazin ... 198
The Iona Snap Switch ... 200
The American Incandescent Lamp ... 200
The Moore Electric Annunciator ... 200
The Bryant Combination Rosette and Receptacle ... 200
The Dollar Electric Motor ... 200
MISCELLANEOUS:
Electricity at the World's Fair ... 190
Election of Officers in the American Institute of Electrical Engineers ... 190
Electrical Lighting in London, by Albert H. Bridge ... 190
Electrical Progress in Germany ... 190
Some Kite Experiments During Thunder Storms, by Alexander M'Adie ... 191
New York's First Electric Street Railway Power Plant ... 192
The Thomson Meter Prize Money ... 192
New Books ... 192
Moonlight Tables for October, 1892 ... 192
The Problems of Commercial Electrolysis—IV., by J. Swinburne ... 193
Fire Risks and Rules in America ... 194
A New Anti-Friction Metal ... 200
FINANCIAL INTELLIGENCE: The Electrical Stock Market, 201: New Incorporations, 201; Affairs of the Companies, 202.
SPECIAL CORRESPONDENCE: New England Notes, 202; Western Notes, 202; Canadian Notes, 203; English Notes, 203.
NEWS OF THE WEEK: The Telegraph, 203; The Electric Light, 203; The Electric Railway, 203; Personals, 203; Miscellaneous Notes, 203.
INDUSTRIAL AND TRADE NOTES ... 203
BUSINESS NOTICES ... 204
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 204

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The Tendency Toward Larger Units. A NOTICEABLE feature of the new power stations in this country is the tendency to the use of larger units in both the electrical and steam equipments. In one of the new central stations to be built in St. Louis for which the contract has just been closed with one of the large manufacturing companies it is announced that only three generators of 800 h. p. each will be used for the operation of 65 cars, each of these being equipped with motors aggregating 50 h. p. This installation will also have that other feature which is becoming deservedly more popular in lighting as well as power plants, of coupling the engine and generator direct to the same shaft. Several large lighting plants already embody this method of construction, but it has not been introduced to any great extent in railway practice.

The Chicago and St. Louis Railway. ALTHOUGH our readers are already familiar with the general plan of the proposed line for a high-speed electric railway between Chicago and St. Louis, the bird's-eye view given on another page will prove of interest, inasmuch as it exhibits in a single illustration several of the leading features of the enterprise. The railway company, while it may not carry out the scheme in all its details as they have been proposed, has nevertheless laid an excellent foundation for what we have always regarded as a commendable undertaking and for which ample capital has been secured to insure the success of the plan by whatever methods are considered to be in accord with the latest and best engineering practice, so far as that practice has dealt with problems similar to those which will come up in the progress of the work. In a new project of this kind, as every one knows, much of its immediate success will depend upon the care taken at every step to secure the best designed and most substantially constructed apparatus that can be turned out by our most reliable manufacturers.

Fire Risks and Rules in America. IN another column we reprint an editorial from an esteemed English contemporary under this caption, in which a number of matters, as seen through the medium of THE ELECTRICAL WORLD, are reviewed in a manner on the whole gratifying to Americans. The writer is correct in his appreciation of the advance made in America of electric light fittings and insulated wire. In fittings especially the advance made during the last two years amounts to a revolution, and we feel sure that those Mr. Binswanger condemns so severely were either of an old type or the product of third rate manufacturers, whose only market would now be in remote places where the electrical insurance inspector has not yet appeared. With the adoption of porcelain cleats, which will soon be required by the insurance inspectors, it is difficult to see any room for further improvement in fittings, except in the case of fixture cut-outs, which are yet in general far from satisfactory. The dissatisfaction expressed by the writer with insurance rules and inspection in England is not, we think, shared to any extent in America beyond disapproval of the great non-uniformity that now exists. Much of the improvement noted above is due to Captain Brophy and the corps of inspectors who have followed his initiative, and we think we echo the sense of the electrical fraternity when we state that the revised rules now in course of preparation will be received in good spirit and conscientiously followed, unless they should depart from the practical and common sense character that, as a whole, have marked previous ones. Perhaps the fact that insurance rules and inspection in America have been thus practical in character and have grown in severity gradually, instead of attempting to attain theoretical perfection at a bound, explains why they have not excited general dissatisfaction in themselves, as appears to be the case with the English system. We cannot see that there is any rational ground in properly prepared rules for the charge of vagueness and ambiguity to which the writer refers, although one can easily imagine how a hostile attitude assumed by one or both sides might readily create very irreconcilable grounds for dispute.

Long Distance Transmission of Electricity. THE enormous demand made upon electrical manufacturers in America by the rapid development of electric lighting, and particularly of electric street railways, has resulted in keeping in the background the less pressing and perhaps more difficult problems, from an engineering standpoint, of long distance transmission of electricity. In the branches first named the engineering questions are relatively simple, or, at least, more uniform in character, with a minimum or no risk in their application, while in the manufacturing department their accomplishment necessitates, in general, merely the duplication of standard types. As a natural consequence, all energies have been devoted to this profitable though restricted field, and the questions requiring more variety, both from the manufacturing and engineering standpoint, have been for the moment disregarded. Perhaps the dominance of the direct current and the suspicion with which alternating current motors have been viewed have also acted as retarding causes, but with the rapidly disappearing system of "systems," which gave rise to these electrical jealousies and prejudices, we are entering an era when professional science will have a free field. We dwell upon these points, because they furnish an explanation why in the branch in question we are so far behind Europe, and why the extensive problems of transmission at Niagara and the Calumet and Hecla mines necessitated the services of European engineers. Recently, however, we are happy to note a general tendency toward a recognition of the demands from this quarter, and once taken up we may look for the same vigorous progress that has placed us so vastly in the lead in the other electrical branches we have made our own. Any one who gives the subject even casual thought must recognize its great possibilities, and it has been a matter of surprise to many impatient waiters for the realization of these possibilities to their profit that their advances have met with so little encouragement from electrical quarters. There are a vast number of important towns and cities in the United States, that are within reasonable reach of water powers, either undeveloped or only giving up a fraction to manufactories alongside them, and often in regions where coal is dear. Even if this power could not be transmitted profitably for ordinary manufacturing uses, it would still in most cases be able to displace the expensive, both in first cost and operation, generating plants for electric lighting and street railways, though to a less extent with the latter, if we assume the continued use of direct current car motors. In the gold and silver mining regions of the West the high price of coal and often excessive cost of delivery render that field a peculiarly adaptable one, and here the work has commenced that will soon render electrical transmission the peer of its now overtowering rivals. The superior engineering qualities that will be developed in this department will not only have their effect in others, but the greater variety in design will besides exerting a directly beneficial effect, have a tendency, no doubt, toward modifying our present too inflexible devotion to standard types of electrical machinery. Before long we hope to have in our columns a gradually increasing section devoted to electrical transmission that will in time rival those now devoted to current electrical development.

Compensation of Electrical Instructors. IN the thorough discussion which has been given to the subject of the technical education of the electrical engineer, one point seems to have been left untouched, namely, the great scarcity of competent instructors who are willing to accept the positions offered to them in the various engineering schools of the country. This fact may not be generally known, but we could name at least a dozen vacancies of this kind at the present time, although the season is at hand for the opening of the fall session of most of the engineering schools. To one who examines the question carefully it will be very evident that the reason for this scarcity of competent men for these positions is that those who are fully qualified to give the proper instruction in electrical engineering can almost invariably obtain better paying positions in commercial work. The range of salaries for assistants and instructors in the engineering schools is from $300 to $1,500 per year, while men who are competent to take these positions would receive in commercial work salaries ranging from $600 to $2,500 per year. We know of one prominent institution in which the professor of electrical engineering has been diligently searching all summer, by correspondence and by interviews, to obtain suitable men for three vacant positions, and he has found it to be a fact that men who can draw $300 as instructors are now getting in commercial work $600, or double the salary offered, and the same thing is true of men who have been sought after to occupy $500 and $1,500 positions. The invariable reply of these men is that commercial work pays them better, and if a man is found who is willing to take a $600 position, it is owing entirely to the additional opportunities which he will have for original investigation. What is true in this specific instance is true of at least four other institutions we might mention. This condition of affairs is certainly to be regretted, since the work of the instructor is assuredly as important as that which the same man would carry out in a line of a more commercial nature. It would seem as if this condition of affairs must lead to one of two results—either our institutions of learning must be content to take inferior men to give instruction to the engineering students, or the salaries offered must be raised to such a figure that competent men may be induced to engage in this work. The salaries offered are certainly very much below what should be considered a fair compensation for the work expected of the instructors in our engineering schools. To be sure, some institutions give as an excuse for the low salaries offered that they require but a few hours a day, or even a week, of their instructors, and that the remainder of their time is at their disposal for doing outside work. To the majority of these men, however, an individual outside practice is next to impossible, although a few who occupy positions at the head of large engineering schools are able through the reputation which they have acquired to add very largely to their incomes in this way. There are other institutions, however, that do not allow instructors even this privilege, in which case they must depend entirely upon their compensation as instructors. It would seem as if technical education of an engineering nature, owing to its importance in the industrial world, demanded the employment of the best men obtainable, and if our leading universities expect to obtain these men they must offer them such inducements that positions of this kind will be chosen in preference to commercial work.

Electricity at the World's Fair.

(From Our Own Correspondent.)

SOME days ago Mr. Frederick Sargent returned from his Eastern trip, during which he arranged for all the necessary condensers, pumps, belting, etc., required in the power plant in Machinery Hall, but needs a few more feed-water heaters. Mr. Sargent states that he finds manufacturers only too ready to loan both electrical and steam apparatus to the Exposition officials, as, in the eyes of many purchasers, the value of machinery is enhanced by having been employed in the Exposition, and this increase in value will offset the preliminary expense, and enable the public-spirited manufacturer to reap the full benefit of the grand advertisement without expense. In the Machinery Hall and annex the boilers are being rapidly erected, and the National (of New Brunswick), the Babcock & Wilcox, and the Zell will probably be supplying the steam before the end of the month. Ball & Wood, Buckeye, and other engines on the grounds, are being placed on the foundations as rapidly as possible. Chief John P. Barrett will visit St. Louis, Louisville, Washington, New York, and other Eastern points early in October. While attending the Fireman's Convention in St. Louis, he will endeavor to have that association hold its next meeting in Chicago, and has secured the promise of the use of the Washington Park race course for trials of speed. Chief Barrett will make a special visit to Washington, and there call on the Henry family in the hope of securing the experimental apparatus used by the professor in his early work in electricity. While in New York he will participate in the Columbian exercises on Oct. 12, and then return to Chicago.

Bids for forty more electric launches have been called for in addition to the forty that are to be operated by the New York Electric Launch and Navigation Company.

The Belknap Motor Company, of Portland, Me., is preparing for quite an elaborate exhibit of its motors and apparatus. A 10-h. p. generator belted to the main line shaft and a compound dynamo and engine furnish current for a 5-h. p. electric motor, which is to be connected by a belt to a pump. This pump supplies water pressure to three combined water motors and dynamos and also to a piston motor for church organ work, and a cyclone mill. Seven different sizes of water motors will be exhibited. The two generators also will furnish current for a 1-h. p. motor, which will run a printing press and two Cyclone coffee mills, which will be kept in operation during the exhibition. There will also be a number of other Belknap motors performing various kinds of work, as well as other novelties manufactured by this company.

In the last issue on page 182, mention was made of the "Frick" reflectors. This was a mistake, as the name of the well-known reflector is the "Frink."

Chicago, Sept. 17, 1892. F. de L.

Election of Officers in the American Institute of Electrical Engineers.

At the annual meeting of the Institute, held in New York City, May 17, 1892, it was voted that a committee be appointed to revise the existing method of electing officers, to report at the general meeting in Chicago in June. The president appointed the following members to serve on this committee: Dr. F. Benedict Herzog, chairman; Mr. Francis R. Upton and Mr. T. C. Martin.

The report printed below was submitted at Chicago. It was voted that the report be printed and a copy mailed to each member, but that action upon the report be postponed until the first regular meeting in New York City. After considerable discussion an informal vote showed that the sentiment of those present was entirely favorable to the proposed plan. The committee's report was as follows:

V. ELECTION OF OFFICERS.

During the first week in February of each year the secretary shall mail to each full and associate member of the Institute a list of members, a list of the offices to be filled at the ensuing annual election in May, giving the names of the incumbents, and a copy of this rule, with the request that nominations, propositions and suggestions as to desirable candidates be made promptly and prior to March 1.

The secretary shall submit all answers to the Council, who during the month of March shall prepare a complete ticket to be headed "Council Nominees," containing the names of members whom they deem best suited, all circumstances considered, for the offices falling vacant. This ticket shall be printed on the same sheet with a "General Proposal List," containing the names of all eligible members proposed, with a memorandum stating the reason of ineligibility of all other names proposed, and with a statement that the nominations by the Council are in nowise governing, but are intended only to assist members in making a choice. The voting shall be restricted to the names on this sheet. This sheet, together with an envelope, on which shall be printed the address of the secretary, and the words "Voting Envelope—Inclosing a Ballot Only," shall not later than the 15th of April be mailed by the secretary to every member in good standing.

Each member may cast three votes for vice-presidents and he may cast all three votes for one candidate or two for one and one for a second, or one for each of three. Each member may cast four votes for managers, which he may in like manner divide between from one to four candidates. This division shall be specified by the appropriate numeral marked opposite the desired name.

All names voted for shall be written, printed or otherwise marked on a single ticket or ballot, which shall be inclosed in a sealed, unmarked and unidentified envelope of any suitable size to be in its turn inclosed in the voting envelope received from the secretary. On this outer envelope the member shall add his signature, and the postage stamp.

At the annual meeting these outer "voting envelopes" shall be opened in the meeting room by two tellers, then and there appointed by the presiding officer. After all the inner envelopes shall have been thoroughly commingled, they shall be opened and the votes shall be counted by the tellers, who shall report the results in writing. The eligible persons receiving the greatest number of votes for the respective offices shall be declared duly elected. The tellers shall reject all names that do not appear on the "council nominee" list or the "general proposal" list, and they shall also reject that part of a ballot which shall name for any office or offices more candidates than there are vacancies.

This method of election shall apply to the offices of president, vice-president, treasurer and manager. No unsalaried officer except the president and treasurer shall be eligible to immediate reelection to the same office (as provided in Rule IV.). The secretary and any other salaried officer shall be chosen each year from among the members of the Institute by the Council. The secretary shall be a member of Council but shall have no vote in its proceedings.

The following is the section of the existing Rules which it is proposed to amend:

V. ELECTIONS.

The annual election shall be held in the city of New York, on the third Tuesday in May of each year. Nominations of officers may be made in writing to the secretary at any time previous to the meeting, but the vote shall be by ballots deposited only by members actually present. *Provided*, that no member or associate in arrears since the last annual meeting shall be allowed to vote until the said arrears shall have been paid. If for any reason it is deemed proper to postpone the election, it may be adjourned from day to day with the consent of two-thirds present or voting.

The following is the existing rule regarding amendments.

VIII. AMENDMENTS.

The rules may be amended at any regular meeting by a two-thirds vote of the members present, provided that written notice of the proposed amendment shall have been given at a previous meeting.

Electric Lighting in London.

BY ALBERT H. BRIDGE.

It can safely be said that success is now beginning to attend the labors of the City of London Electric Lighting Company. Of course, there is not yet a dividend for distribution, but the directors have cause to look cheerfully into the future. At the second annual meeting, held on September 1st, at London, Sir David Solomons, Bart. (chairman), said that regarding what had been done since the company's previous meeting, he might mention that whereas up till that time aplication had been made for shares to the extent of about £300,000, the remaining £100,000 had since been applied for and allotted. The directors hoped within twelve months to be able to pay a dividend on the ordinary capital.

The consumption of current per lamp installed in city offices, shops, etc., far exceeded what was in the first instance anticipated. On the 30th of June there was installed machinery of a capacity of 700 public arc lamps and 23,000 8-c. p. glow lamps. The gross earnings of the company at present exceed £20,000 per year. In the public streets there were 184 arc lamps at the end of June; now there are 334, and in a fortnight's time nearly the whole of the lamps would be running. The last day of the contract is Nov. 5, and by that date the work will have been completed for nearly two months. The demand for private lighting was exceedingly good. Applications were received in June for 32,028 lamps, 11,860 of which had already been connected up. The report and accounts were unanimously adopted.

The principal streets in London are now brilliantly lighted with electricity, and much satisfaction is being expressed at the improvement. The gas lamps are not for the present to be taken down, and men are being retained to light the gas should it be found necessary.

Electrical Progress in Germany.

(From Our Special Correspondent.)

The question of a central station for the eastern suburbs of the city of Berlin is being discussed in industrial circles and by landowners in that district. The Allgemeine Elektricitats Gesellschaft, who propose to carry out the work, have completed the preliminary details connected with the project. On the basis of the reliable data and estimates furnished, it seems probable that electric current may be supplied for lighting purposes at the same price as gas, and current for motor work will be so cheap that in many, perhaps even in most, cases, it will offer considerably greater advantages than steam. The price for current is to be about 12 cents per kilowatt hour for lighting, and about 2½ cents for power purposes. Rebates would be allowed customers using a large amount of current in the year.

Messrs. Siemens & Halske have been awarded the contract for a complete central station lighting plant for the Valparaiso Gas Company. The station is planned for a maximum capacity of 2,000 incandescent lamps. Ample provision will be made in the buildings and general arrangement of the plant for a possible future extension in the station output up to 6,000 lamps. The well known interior pole type of Siemens dynamo will be used, with an accumulator battery of 450 ampere hours' capacity. The dynamos will be coupled direct to gas motors. A plant of similar total machine output will also be furnished to the same company by Messrs. Fritsche & Pischon, Berlin. The three-wire system will be employed. The gas motors will be furnished by the Berlin Anhaltische Maschinenbau Aktien-Gesellschaft, of Dessau, and the accumulators by the Hagen Accumulator Works, Hagen, Westphalia.

The question of introducting a law for controlling the conditions of the erection and running of electrical installations has been mooted in Berlin, and in certain circles it is thought that such a measure should have been passed simultaneously with the recently promulgated telegraph laws. It is probable, however, that a bill of this kind will be laid before the Reichstag soon.

The Federal Council has been engaged in deliberating upon the matter for some time, and the measure has, in its chief points, been pretty well settled. Although it is not yet certan in what form it will be presented to Parliament, this much, at least, is probable, that it will make provisions by virtue of which the Federal Council will be employed to lay down certain police regulations, on the basis of which, again, the general conditions in reference to the erection and running of electrical installations on or beneath public property will be determined.

The prices of incandescent lamps have again been considerably reduced. Important continental factories are supplying lamps at as low a figure as 20 cents apiece, and there is, it is said, nothing to prevent prices from falling still lower.

At the instance of the Electrotechnischer Verein, arrangements have been made for holding day classes for the instruction of electrical "monteurs," or erectors and fitters. The object of these classes is the theoretical training of electrotechnical assistants, so far as to make them competent as fitters or erecters, foremen, and for similar positions in large works. The course is half yearly. The subjects embraced are as follows: 1. Physics. 2 Chemistry. 3. Mathematical exercises. 4. Drawing. 5. Special electrical knowledge, comprising batteries and accumulators, electrolysis, telegraphy, telephone and signaling apparatus, lightning arresters, dynamos and motors for driving the same, the technics of electric lighting, and electrical instrument making.

All these subjects will be treated exhaustively, a total of 48 hours per week being devoted to them. The conditions of entrance to the school are:

1. Pupils must have served a three years' apprenticeship with an electrical firm, in some mechanical business, or in a machine shop; and have worked at least one year as assistant in a similar line.

2. They must be able to express themselves correctly in writing. No flagrant errors in orthography will pass.

3. They must possess a certain aptitude for drawing.

4. In mathematics, pupils will be required to be conversant with the first principles of algebra; also the solution of simple equations, involving one unknown quantity; calculations with vulgar and decimal fractions, proportion, the simpler commercial calculations, the elements of geometry, and the simplest forms of geometrical construction. The fee for the half year is 100 marks—about 24 dollars. The school is to open on the 10th of October next. Much interest has been manifested in the scheme by all the leading electrical firms in Berlin, among whom may be mentioned Messrs. Siemens & Halske, the Allgemeine Elektricitats Gesellschaft, the Union Elektricitats Gesellschaft, the Berliner Electricitatswerke, Gebruder Naglo and Messrs. Schwartzkopf.

No less than 16 different projects have been submitted for a central electricity supply station for the city of Dresden. It is hoped, however, that a decision may be arrived at, and arrangements concluded with some one of the tenderers, by the middle of October. All the firms who have sent in offers have engaged to carry out the work, as at present planned, within 12 months from the date of contract. It is proposed to erect a plant at first for an aggregate of 115,000 16-c. p. lamps, of which number 110,000 will be required to be burning at the same time.

The local Town Council of Strassburg is busy with the question of the erection of a central station for lighting and power purposes. Herr Oscar von Miller has been intrusted with the working out of a project which is to be ready within two months. The Tramway Company has interested itself in the matter of applying electric traction to its lines, and negotiations are pending with the Union Elektricitats Gesellschaft, of Berlin, who are exploiting the Thomson-Houston system in Germany.

A portion of the electric tramway at Stuttgart was opened on the 24th August, after several days' trial running, and the results attained were in every way satisfactory. In order to thoroughly test the efficiency of the electric system, a section of the line was chosen that offered special difficulties to traffic, with a considerable grade, curves, branches, crossings, etc. The whole of the work was carried out by the Allgemeine Elektricitats Gesellschaft. The line is equipped on their overhead system, the same as in Halle and Gera, where the electric lines have been operating successfully for some time past. The same company also has in hand the installation of important electric roads in Breslau and Chemnitz.

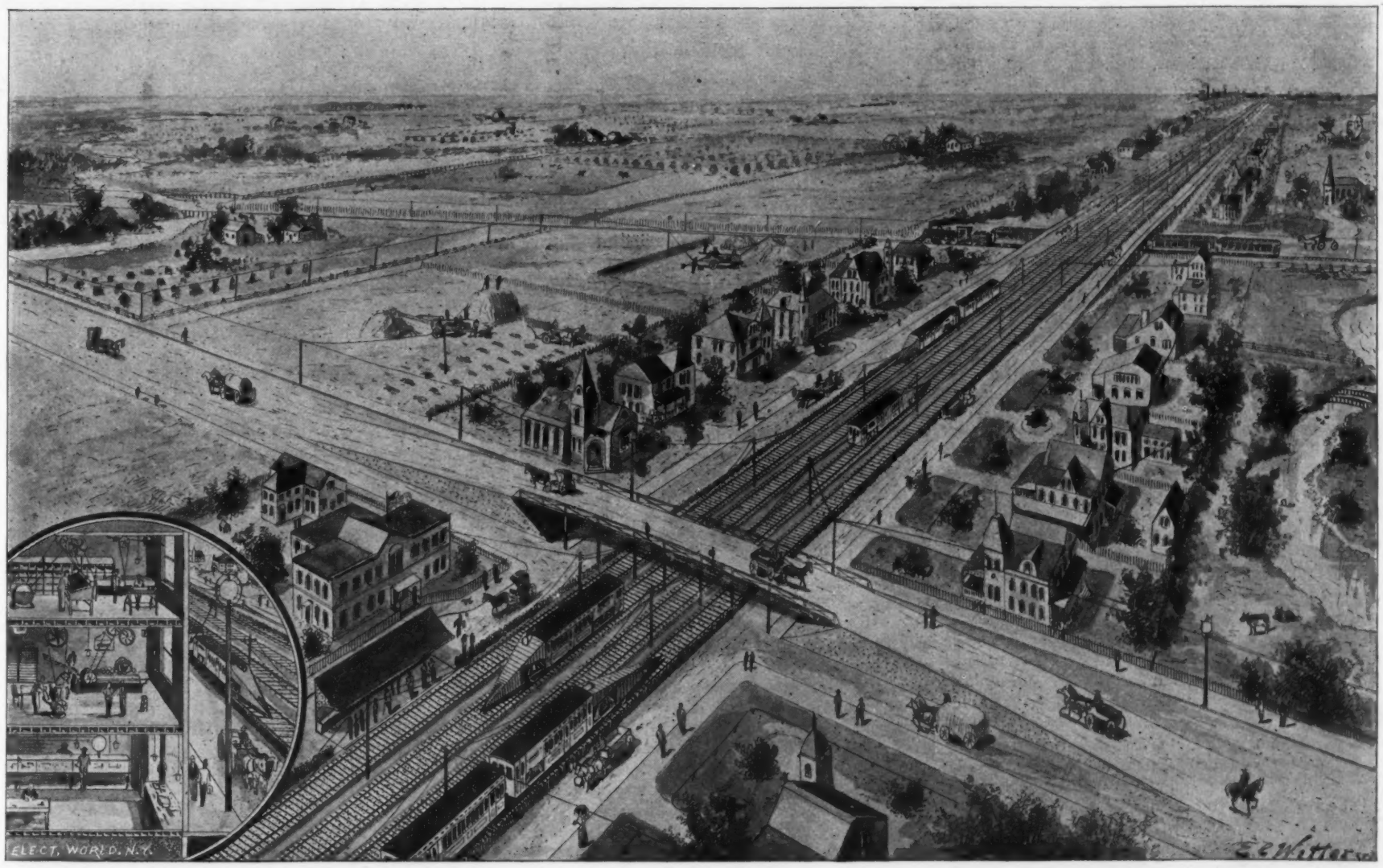
Limburg-on-Lahn is to be supplied with electric current for lighting and motor work, the necessary power being obtained from a stream of water, a little over a mile distant. The installation will be carried out by Messrs. Lahmeyer & Co., of Frankfort-on-Main, while a local company will undertake the running of the central station.

Berlin, Aug. 31, 1892. J. L. H.

The Chicago and St. Louis Electric Railway.

Although very little has been heard for some months of this bold project by which Chicago and St. Louis are to be connected by a high speed electric railway, its projectors have been doing some very substantial work, both in planning the details of the equipment and in obtaining financial backing for the enterprise. The order has been placed for the motor equipment for the first car, the builders guaranteeing to construct a pair of motors that would meet the specifications drawn up by Dr. Wellington Adams, developing the required power to propel the train at the specified speed of 100 miles per hour. The best electrical engineers and the best established financial houses in this country and Europe will assist in the development of the enterprise with a view to the completion of the work in the time originally specified.

The accompanying illustration shows a bird's eye view of the proposed road, and gives, better than any description could, a general idea of its various features. Of the four tracks shown, the two inner ones are to be utilized for express traffic, while the outer ones may serve for the general way service with frequent stations. The entire line of the road will be inclosed, and no grade crossings allowed, the highways being carried overhead, while the road itself will be sufficiently elevated to pass over the steam railways. Both of these features are shown in the illustration, as is also the proposed method of ultimately constructing a boulevard along both sides of the electric roadway. Another feature of the plan, which must ultimately become a most important one, is the distribution of electricity for lighting and power purposes along the entire line of the road, whether for domestic, manufacturing or industrial use. This is also shown in the illustration, where a printing office is exhibited, operated by electric power, farming operations carried on by the same means, and electric lights are utilized for illuminating the streets and residences along the route.



BIRD'S EYE VIEW OF THE PROPOSED CHICAGO AND ST. LOUIS ELECTRIC RAILWAY, SHOWING THE PROJECTED BOULEVARD SYSTEM.

American Institute of Electrical Engineers.

The 69th meeting, and the first of the present season, will be held at the Headquarters of the Institute, 12 West Thirty-first street, on Tuesday evening, September 27, at 8 o'clock. A paper will be presented by Mr. Charles P. Steinmetz, "On the Law of Hysteresis (II.) and other Phenomena of the Magnetic Circuit." Members who are especially interested in the subject may secure advance copies upon application to the secretary. The report of the Committee on Rules for the election of officers, printed elsewhere in this issue, will be taken up. After the discussion, should time allow, members will be invited to contribute notes of their "Vacation Experience," embodying observations on new or curious features of electrical work, in this country and abroad. The council will meet in the secretary's office at 5 P. M.

Some Kite Experiments During Thunder-Storms.*

BY ALEXANDER M'ADIE.

Photographs of lightning make it plain that discharges occur in all directions; from cloud to cloud, cloud to earth, cloud to cloud to earth, and conversely. A majority of these photographs show the discharge to be from cloud to earth. Assume now that in such a discharge we have the case of a "linear oscillator" as Dr. Lodge pointed out some years ago ("Philosophical Magazine," July, 1889). Such an oscillator is simply an air condenser charged to bursting strain. (The breaking strength of ordinary air is roughly ½ gramme weight per square centimetre.) If we hear the thunder five seconds after the flash, and call the average temperature of the air 65° F. (18° C.), since the sound waves travel at something like 343 metres per second, the nearest point of the discharge will be some 1,700 metres away. And the length of the spark may vary from a few hundred to many thousand metres. The discharge will be oscillatory, as Dr. Lodge shows, unless the resistance it meets with exceeds a certain critical value, viz.:

$$R_0 = \sqrt{\frac{4L}{S}} = \frac{16\,h\,\mu\,\nu}{r} \text{ or, say, } \frac{480\,h}{r}.$$

$\mu\,\nu = 30$ ohms.
$L =$ inductance of circuit.

If $h = 1{,}000$ metres, when $r = .05$ m., $R_0 = 9{,}600{,}000$ ohms; $r = 50$ m., $R_0 = 9{,}600$ ohms.

If $h = 500\ m$, when $r = 150$ m., $R_0 = 1{,}600$ ohms; $r = 240$ m., $R_0 = 1{,}000$ ohms.

Our oscillator is sending out waves in the ether, the pulses traveling along with a velocity practically that of light. If this radiation falls upon a conductor of such dimensions that it will act as a resonator, sparks will pass between the ends of the conductor. A kite in air with about 137 metres of No. 22 uncovered copper wire wound around the kite string and about 129 square centimetres of tinfoil on the face of the kite, and the lower end of the wire as well insulated as we can insulate it (for these high potentials the insulation must be very good) and brought within 2 mm. or so of a wire running to ground, is not exactly the resonator we could wish for; and we do not know that its period of oscillation is like that of the lightning oscillator. But if the flash is 500 metres long (a small flash) and we allow 10 electrostatic units to the mm., we get a potential of something like 150,000,000 volts; and if we assume that the capacity of the condenser emptied by the flash is 10 metres, the volume of dielectric suddenly relieved of strain being $= r^2 h$, the energy of the spark will be

$$\frac{981\,\pi\,r^2\,h}{2} \text{ ergs}$$

or, very roughly, something like 15,000 h. p. if r is very small, and 1,000,000 h. p. if r is very large. The capacity discharged is

$$\frac{K\,r^2}{4\,h}$$

and the maximum potential 110 h electrostatic units. When, therefore, during a thunder-storm there occurs a continuous flow of sparks across this 2 mm. gap, we may be getting one of several things; viz.:

1. The kite string may be a conductor of such dimensions that there is a reinforcement of the oscillations at the ends sufficient to cause a spark.

2. The kite wire may be simply a connecting conductor between a mass of electrified air some distance from the ground and the ground, and the sparking entirely independent of the lightning, and not due to the electrical oscillations. If this is the case (and it is interesting to note that we have succeeded in getting sparks from the kite during cloudless weather, we are simply lowering the potential of the air near the kite) it follows that a kite, especially if it have points, is a most effective lightning protector, and that a number of kites would successfully rob the cloud of its charge.

3. With every flash of lightning there is a sudden equalization of the high potentials to which the clouds and earth have been raised. The earth is suddenly brought back to its zero potential and sparks may pass from any partially insulated conductor in the vicinity to it.

4. From photographs it is plain that many discharges consist of a large main path of discharge (or trunk) and numerous ramifications (or branches), and it is possible that some of these smaller discharges may come down the kite wire.

Under 1. Inasmuch as we obtained sparks and the kite wire was 137 metres long, $\lambda = 275$ metres, which means something like 1,100,000 oscillations per second. The rapidity of vibration being directly proportional to the linear dimensions of the system, and our cloud-earth oscillator being a pretty large one, it seems as if these vibrations ought to be slower and the waves longer; 300,000 oscillations per second would mean waves a kilometre long.

For a description of what actually happens, we will take one date, Aug. 9. The kite as described was flown about 11 A. M. and remained up until some time after 10 P. M. At 7.40 the thunder-storm, which had been seen in the west for 20 minutes or so, was near enough to the hill to permit hearing thunder. Sparks without cessation were passing from the kite string, and when this was connected over a Mascart insulator with the needle of the large multiple quadrant electrometer, a sizzling was heard within. Lifting up one of the metallic screens in the side of the instrument the internal parts were seen to be all aglow. The light reflected from the tinfoiled sides of the instrument was strong enough to cast shadows. While handling the wire simultaneous with a flash of lightning quite a strong shock was received. Strangely enough we managed to get a photograph of the flash. The thunder moderately loud and not

*This article is a portion of an investigation made this summer at Blue Hill Observatory, along these lines: 1, Simultaneous records of the potential at the summit and base of the hill, using two Mascart electrometers registering photographically; 2. Records from a large multiple quadrant electrometer registering mechanically; 3. Study of the perturbations of the potential during thunder-storms and the relations of the curves given by electrometer, statoscope, hygrometer, thermometer, anemoscope and anemo-kinemograph, all self-recording instruments; and, 4, Some kite experiments.

prolonged followed in about 4 seconds. A 105-volt lamp placed between the end of the kite wire and a ground seemed full of diffused light. The filament itself did not glow as far as we could see, although there are blackened places now at the ends which we did not notice there before, and it seemed to be rather a case of creeping of the charge over the outside of the lamp. At first we thought that these flarings of the lamp were synchronous with the lightning; but after awhile the lamp flared when we could see no discharges. Stinging sparks could be felt on handling the wire; and holding a ground wire near caused a constant stream of small sparks. Rain began about 8.10 P. M., and was over in a few minutes; 1-100 inch of rain fell. And now followed what seemed to us the most noteworthy thing about these observations. To the northeast over Marblehead, Lynn, Boston, etc., was a great display of distant lightning with occasional strong discharges. As the next morning's papers show, considerable damage was done. We could hear no thunder, and although we tried long we could not photograph the flashes. And although the electric phenomena were to be thus plainly seen 10 to 15 miles away there were no sparks and no flarings of the lamp. When the storm was the same distance to the west and south of us, the sparking was quite pronounced. For reasons which need not be gone into here, we do not think that the light rainfall was a determining factor. This observation may perhaps be of importance in considering the influence of auroral displays upon the potential of the air near the earth's surface, which as the readers of The Electrical World may or may not know is a very open question; the records at some observatories showing an apparent influence, at others, none.

U. S. Weather Bureau, Washington, D. C.

New York's First Electric Street Railway Power Plant.

At West Farms, not far from the old Boston Road, stands the first electric street railway power station erected in New York City. Perhaps the most noticeable thing about it is the towering brick chimney; which is over 200 feet in height. This station has been constructed for supplying power to the Harlem Bridge and Fordham Electric Railroad and its branches. Already 20 miles of double track have been laid and as many miles of trolley wire suspended.

The power house is a brick building 200 feet long by 75 feet wide. The roof is supported by an iron truss frame. A 75-foot traveling crane rolls on an iron track which forms the top of the walls and extends the whole length of the building. This crane has a lifting capacity of 30 tons and is intended for general work in the station. Four 500 h. p. Babcock & Wilcox boilers, and four large copper compound condensing Corliss engines of 400 h. p. each form the steam plant. The driving wheels of these engines are 20 feet in diameter, with a 41-inch face and have a speed of 72 revolutions per minute.

Directly belted to these engines are four 300 kw. Thomson-Houston multipolar generators. These machines are well insulated from the earth by being raised an inch from the concrete foundation, and the space filled in with melted sulphur, which forms a solid bed around the base of the dynamos, insuring perfect insulation and a permanent anchorage.

At present only two of these generators will be needed to supply the line, and the other two will be held as a reserve. The station has been built of sufficient size to admit of doubling its capacity without any change in the part which has already been completed.

Several miles of this line run under the elevated structure of the Suburban Elevated Railroad, and the method of supporting the trolley wire from the elevated structure was fully described in The Electrical World of August 20, 1892. Thirty cars equipped with Thomson-Houston single reduction motors will soon be in operation. Cars have been running for several days on the Third avenue and Boston Road lines with entire success, gaining about 30 minutes in the round trip over the horse cars which they replaced.

The Thomson Meter Prize Money Again Offered as a Literary Prize.

Our readers are aware that at the last prize contest instituted by the city of Paris for the best electric meter the prize of 5,000 francs was awarded to Prof. Elihu Thomson. With the desire that this sum should serve for the development of the theoretical knowledge of electricity, he has requested Mr. Ernst Thurnaur, general manager for Europe of the Thomson-Houston International Electric Company, to offer a prize for the best work on a theoretical question in electricity, and to organize a committee who should propose the subjects, examine the productions and decide the prize. The following gentlemen have been chosen and have consented to act as members of the committee: J. Carpentier, president of the Société Internationale des Electriciens; Hippolyte Fontaine; E. Hospitalier, professor in the School of Physics and Chemistry of the city of Paris; E. Mascart, member of the Institute; A. Potier, member of the Institute, examiner; B. Abdank-Abakanowicz, Consulting engineer, secretary of the committee.

The committee has decided that the prize should be given for an investigation on one of the following subjects:

1. The heat developed by successive charges of condensers under different conditions of frequency, nature of dielectric and quantity of charge.

2. It has been shown theoretically that when the two surfaces of a condenser are connected by a conducting body, the condenser becomes the source of alternating currents as soon as the resistance of the conducting body decreases below a certain limit. The formula that permits calculating the period of this oscillation has not yet been completely verified. This period of oscillation should be investigated experimentally under conditions such that the exact measure of resistance, capacity and coefficients of self-induction may be possible in order to arrive at a complete and precise verification of this formula.

3. When a condenser made with an imperfect insulating material has been charged and then left to itself, the charge is gradually dissipated. The time necessary for the charge to be reduced to a given fraction of its initial value depends only on the nature of the insulating material. It is proposed to investigate whether, as certain recent theories would seem to indicate, analogous phenomena do not present themselves in metallic conductors, and whether these can be shown experimentaliy.

4. It is proposed to arrange and systematize our present knowledge of the graphical solutions of electrical problems, and deduce from them some general methods as in graphical statics.

The theses presented may be written in English, French, German, Italian, Spanish or Latin. They may be in manuscript or printed. Each thesis presented must be signed by a pseudonym, and accompanied by a sealed envelope bearing the same pseudonym on the outside, and with the name and address of the author inside. The papers must be sent before Sept. 15, 1893, to B. Abdank-Abakanowicz, consulting engineer, the secretary of the committee, at 7 Rue du Louvre, Paris, who will furnish any further information required.

NEW BOOKS.

DESCRIPTIVE INDEX OF CURRENT ENGINEERING LITERATURE: 1884-1891 (inclusive). Chicago: Published by the Board of Managers of the Association of Engineering Societies, 51 Lakeside Building. 1892. 475 pages. Price, $2.50.

The material of which this volume is made up has appeared in the monthly numbers of the "Journal" of the Association since 1884 under the title of "Index Notes." This matter has now been collected into one volume and classified under subject headings which are arranged alphabetically. Numerous cross references have been added to assist the searcher in finding all the references that bear upon any given subject. About 100 technical journals and society publications have been indexed by men who were practical engineers rather than mere cataloguers, so that they were able to judge intelligently whether articles were of sufficient importance to warrant a reference to them. It is to be regretted, however, that the electrical section of the volume was not carefully revised by some one more familiar with the literature of electricity, and with contributors to the electrical journals, as this seems to be the section of the book with which its compilers were the least familiar. An electrical engineer is not likely to be very much impressed with the book's claims to accuracy—and lacking this any index is practically valueless—when he finds in the 30 pages devoted to electrical subjects the names of 20 well known electrical authors either misspelled or given with incorrect initials. In addition to this the classification is very imperfect. Sir Wm. Thomson's electrical instruments are found under the heading "Elastic Balance," and more than a page of titles on "Electric Lighting" appear under the heading "Electrical Measurement." The body of the book, however, referring to general engineering literature seems to be much more intelligently edited and more carefully "constructed." No claim is made to completeness, as an effort has been made by the compilers "to select only that which has some permanent value, and to append to each title such a description of it as would enable one to decide whether or not it would be worth his while to look it up."

Notwithstanding the defects we have mentioned the index, as an addition to a much needed and very useful class of books, should find a place in the library of every engineer who wishes to make a profitable use of the valuable literature to which it serves as a guide.

THE COMPARATIVE MERITS OF THE VARIOUS SYSTEMS OF CAR LIGHTING. By A. M. Wellington, W. B. D. Penniman and C. W. Baker. New York: Engineering News Publishing Company, 1892. 303 pages and 77 illustrations.

This little book is made up of a series of articles on this subject that appeared in *Engineering News* at various dates, begnining April 18, 1891, and the information contained in it is based upon original investigations and tests made expressly for that journal with the best available statistical records. The investigation covers the comparative cost, safety, light giving powers, and general advantages of oil lamps, compressed gas, gasoline carbureters and electric light. A chapter devoted to electric lighting covers the systems using the primary battery, the track wire, the storage battery, the direct dynamo, and the combined storage battery and dynamo, as well as some account of electric train lighting in England, and of the American practice of the combined dynamo and storage battery system. Some figures are given of the comparative cost of the different electric systems. An appendix contains an account of car lighting by the storage battery on the Jura & Simplon railway in Switzerland. For those who wish to make a study of the comparative value of different systems of train lighting, the book will be found to contain a mass of valuable information which has been collected and arranged in systematic shape by the editors of *Engineering News*. The value of the work is very much increased by the complete index which accompanies it.

THE LAW OF ELECTRIC WIRES IN STREETS AND HIGHWAYS, by Edward Quinton Keasbey, of the New Jersey Bar. Chicago: Callaghan & Co. 1892. 190 pages.

This is the first comprehensive treatise on this subject, and, while it is primarily a law book for the use of the legal fraternity, it certainly deserves a place on the desk of the manager of every telephone, telegraph, electric light and electric railway company where questions must be decided from day to day regarding the respective rights of property owners and corporations to the privileges of the public highway. The subject is elaborately treated and hundreds of typical cases cited in connection with each feature taken up for discussion.

LITERARY NOTES.

The seventh edition of "The Dynamo; How Made and How Used," by S. R. Bottone, has been issued by Swan, Sonnenschein & Co., of London, and D. Van Nostrand, of New York. This edition contains additional matter and illustrations relating to the construction of more modern types of machines and covers in all just 100 pages, with 60 illustrations. The price of this new edition is $1.00.

We are able to announce this week the issue of "Recent Progress in Electric Railways," by Carl Hering. The book contains more than 300 pages and is fully illustrated with cuts of all recent electric railway apparatus. It is uniform in style, size and price with the American edition of Prof. S. P. Thompson's "Lectures on the Electromagnet," and will prove a very convenient reference book on the subject uf which it treats.

"The Fire Hazard of Electricity" is the title of a pamphlet just issued containing a course of lectures upon this subject before the Fire Underwriters' Association of the Pacific, by Geo. P. Low, electrical inspector of the Pacific Insurance Union. The papers here reprinted in collected form were prepared particularly for the enlightenment of the fire underwriters in relation to a special hazard, and, generally, for the education of electric wiremen in a direction hitherto neglected.

We have received from Mr. Gardiner M. Jones, the librarian of the Salem (Mass.) Public Library, one of the monthly bulletins of the library containing a list of books on electricity and its applications now in the library. The list shows a good selection of general and special works numbering about 200 volumes. This list containing most of the later works on the subject is regarded by Mr. Jones as more generally useful for the average reader than an extensive bibliography. The list is certainly a creditable one and must prove of service to the library's readers.

"Telephones, Their Connections and Circuits" is sent out from the General Electric Company (of London and Manchester), to two of the directors of which, Messrs. G. Binswanger, M. I. E. E., and M. Binswanger, A. I. E. E., the trade is indebted for this unique little treatise. The intention of the compilers, as announced in the preface, is "to assist those who may have occasion to instal and maintain telephone systems," and this intention the subsequent pages are admirably calculated to fulfill. The treatment in the main being diagrammatical, the necessity for lengthy description is removed, and the explanations are concise and succinct—both matters of vital importance in a work of this sort, as practical men have not the time to read a ponderous volume, and it is from such readers rather than from scientific investigators that this little manual will meet with success. The General Electric Company supplies the book free to the trade, extra copies being sold at 6d. eac.

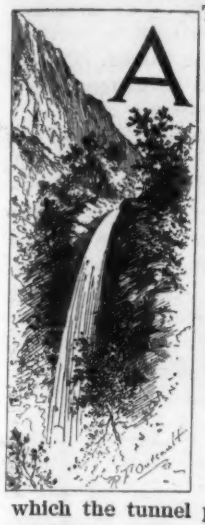
Moonlight Tables for October, 1892.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of October, under his modified form of moon schedule:

TABLE NO. 1. Standard Moonlight, Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1				1	6:15 P. M.	2	4:55 A. M.
2	12:15 A. M.	2	5:00 A. M.	2	6:10	2	12:00 M.
3	1:30	3	5:00	2	12:15 A. M.	2	5:00 A. M.
4	2:45	4	5:00	3	6:10 P. M.	3	12:00 M.
5	No light.	5	No light.	4	6:10	4	12:00
6	No light.	6	No light.	5	6:05	5	12:00
7	No light.	7	No light.	6	6:05	6	12:00
8	6:00 P. M.	8	8:05 P. M.	7	6:05	7	12:00
9	6:00	9	8:45	8	6:00	8	12:00
10	6:00	10	9:35	9	6:00	9	12:00
11	5:55	11	10:30	10	6:00	10	12:00
12	5:55	12	11:35	11	6:00	11	12:00
13	5:55	14	12:45 A. M.	12	5:55	12	12:00
14	5:50	15	1:50	13	5:55	14	12:45 A. M.
15	5:50	16	3:00	14	5:50	15	1:50
16	5:50	17	4:00	15	5:50	16	3:00
17	5:45	18	5:15	16	5:50	17	4:00
18	5:45	19	5:15	17	5:45	18	5:15
19	5:45	20	5:15	18	5:45	19	5:15
20	5:45	21	5:20	19	5:45	20	5:15
21	5:40	22	5:20	20	5 45	21	5:20
22	5:40	23	5:20	21	5:40	22	5:20
23	5:40	24	5:20	22	5:40	23	5:20
24	5:40	25	5:20	23	5:40	24	5:20
25	6:55	26	5:20	24	5:35	25	5:20
26	7:50	27	5:25	25	5:35	26	5:25
27	8:50	28	5:25	26	5:35	27	5:25
28	10:00	29	5:25	27	5:30	28	5:25
29	11:05	30	5:30	28	5:30	29	5:25
30				29	5:30	30	5:30
31	12:20 A. M.	31	5:30	30	5:25	31	5:30

Total hours, 203.50.

The Utilization of Niagara Falls.



AT Niagara Falls work on the tunnel is now well advanced. From present indications it appears that the construction of the tunnel is ahead of that on the wheel-pits and machinery of the first industries to utilize the power thereby made available. The project was described at length in our issue of Feb. 6, 1892; and although changed in some of its details, has been carried out in its main features upon the lines there shown. For some information regarding the progress of the work, and for the large illustration of the project on page 149 we are indebted to a recent article in "Power." According to this article the most important modification is that, whereas it was at first intended to allow the rock through which the tunnel passed to form its wall, it was found necessary, from the nature of the rock and the amount of water encountered, to line the tunnel with brick. This has been done in the manner shown in the illustration, the lining being 16 inches thick, and requiring about fifteen million bricks. The space between the brickwork and the rock was filled with broken stone and cement, the supporting timbers being built in as shown. This lining has reduced the capacity of the tunnel from the 120,000 h. p. at first contemplated to about 100,000 h. p. Its finished height is 21 feet and width 19 feet, with a cross-sectional area of 365 square feet for its entire length of 7,600 feet. Its grade is about one foot in 150, and there is a difference of about 200 feet in the level of the water in the canal and the tunnel discharge, about 140 feet of which will be available as working head for the turbines.

To the manufacturer who locates at Niagara two methods of procuring power are available. He may either put in his own wheel-pit, penstock, and wheels, and discharge the water into the tunnel as a tail race, or he map equip his factory with electric motors and obtain his current from the immense power house which the Niagara Falls Power Company will construct and operate.

The first establishment to put in an installation upon the first mentioned plan will be the Niagara Falls Paper Company, which is building what will be the largest paper mill in the world. It will be situated upon reclaimed land at the river side. The water taken from the canal, as shown, will be delivered through a single penstock upon six turbines of the Geyelin-Jonval type (furnished by R. D. Wood & Co., of Philadelphia), and discharged through a supplementary tunnel some 800 feet in length to the main tunnel. From each turbine a vertical shaft extends to the mill above, connecting, through bevel gears, with the pulp grinding and other machines and shafting.

The work has not yet assumed a sufficiently definite shape to allow of a detailed description. A general idea of the arrangement is shown at the left of the illustration (Fig. 4). The turbines are 4 feet 8 inches in diameter, and are to run at 270 revolutions per minute, under a head of 140 feet, developing 1,100 horse power each. Three of the turbines are now in process of construction, and will be ready early in the coming year.

This method of utilizing the power of Niagara will be practicable only for industries of considerable magnitude. For the smaller manufacturer the electric motor supplied with cheap current from the larger power house where it can be most economically generated will doubtless be the most economical arrangement. To meet this demand the Niagara Falls Power Company is putting in a station where there will be installed primarily two turbines of 5,000 horse power each, built in this country from designs furnished by Faesch & Piccard, of Geneva, Switzerland. The vertical shafts of the turbines will carry at their tops the armatures of two multipolar dynamos, to utilize the capacity of the wheel. The weight of the bearings is supported by the pressure of the water under the running head.

This station is so designed that it can be extended to an ultimate capacity of 50,000 h. p. The projected arrangement is shown in a general view at the

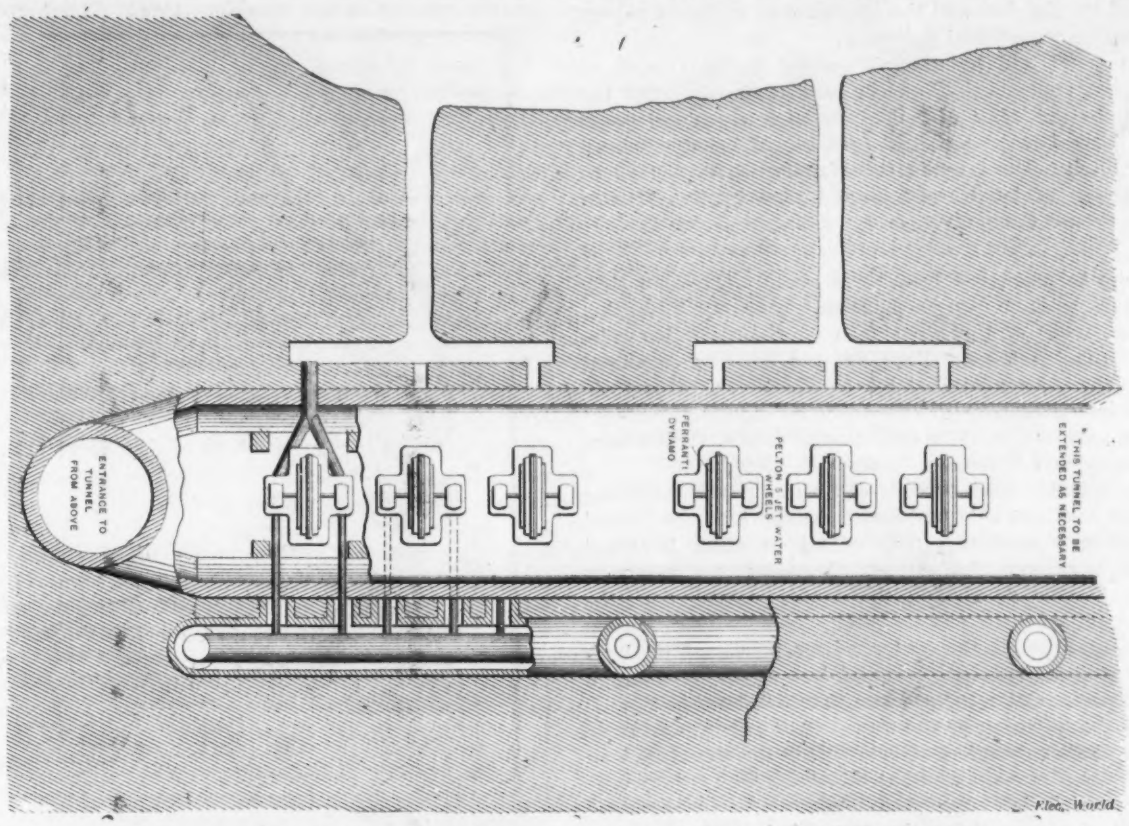


FIG. 2.—SECTION OF PROPOSED TUNNEL ON THE CANADIAN SIDE.

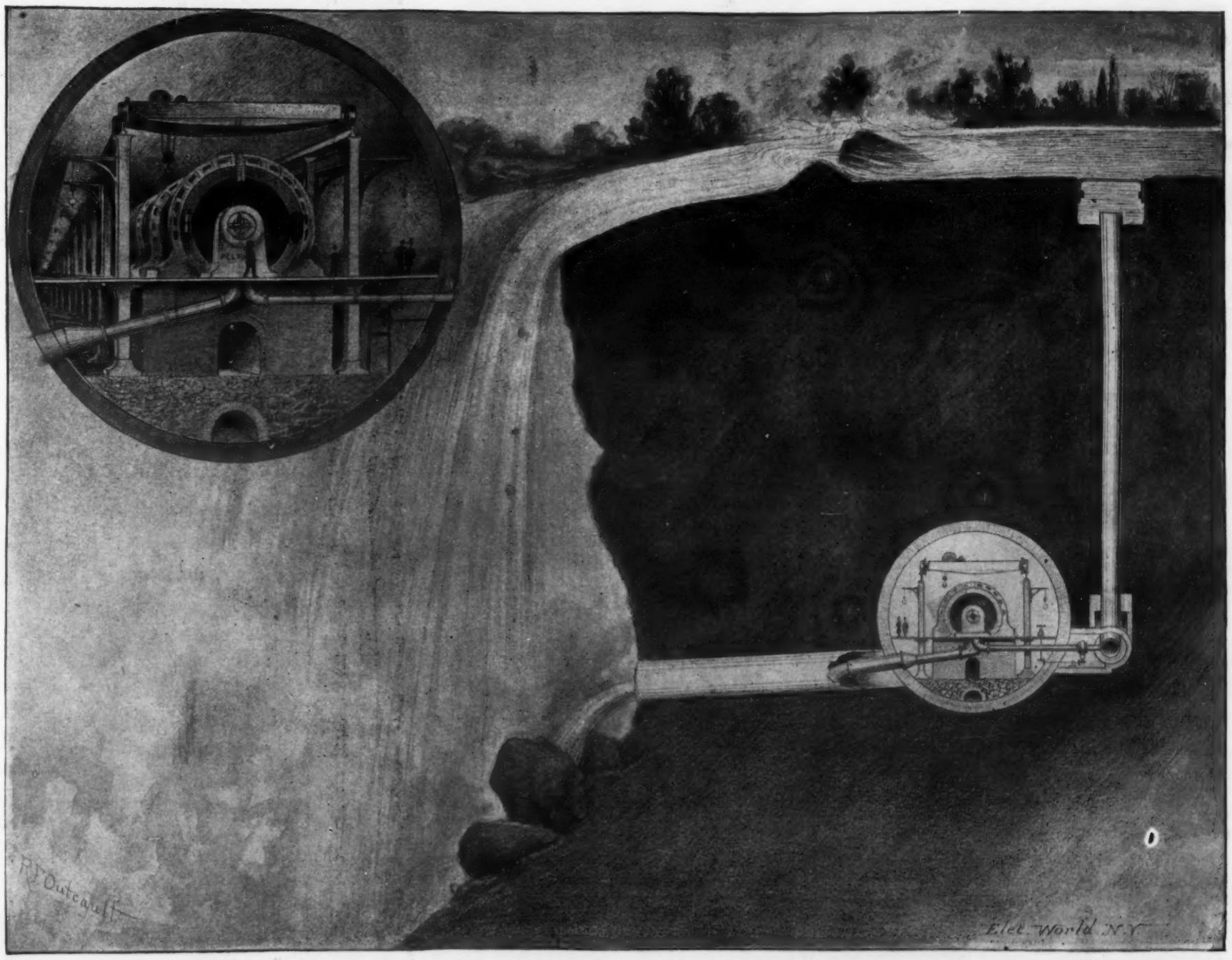


FIG. 1.—SHOWING PROPOSED PLAN FOR THE UTILIZATION OF NIAGARA FALLS ON THE CANADIAN SIDE.

right in the illustration (Fig. 4). The wheel-pit is now being excavated. It is 140 feet in length and 18 feet in width; and the difficulties encountered from inrushing water are suggested in one of the panels of the engraving, which is reproduced from a photograph. The construction of a coffer dam and the continual operation of power-full pumps were found necessary.

The canal will be extended along Buffalo street or Adams avenue, as shall appear most desirable, when the character and location of the industries which will use it shall have been determined, the tunnel being extended accordingly. The land in the vicinity of the canals to the extent of 1,400 acres is controlled by the Niagara Falls Power Company.

While so much has been done on the American side, active steps have also been taken toward the utilization of the power of the great falls on the Canadian side. The Canadian Power Company was recently organized under the charter granted by the Parliament of Ontario at its last session, with the following officers: President Albert D. Shaw, Vice-President Francis O. Stetson, Secretary and Treasurer William B. Rankine.

The valuable concession of the water power privileges on the Canadian side of Niagara passed into the control of this new company, 60% of whose stock is owned by the Cataract Construction Company, the company which is now developing the tunnel scheme on the American side. It will be seen that one corporation really controls all the water power privileges on both sides of the great cataract, and has at its command a water power estimated at more than 3,000,000 h. p.

It is the intention of the Canadian Power Company to await further practical developments on the American side before determining what the character of the works shall be. It is proposed to make the Canadian side furnish the means for the transmission of power to Buffalo and other distant points. As is well known the possibilities on the Canadian side within the limits of Queen Victoria and Niagara Falls parks, where the company has exclusive rights, are very great for the development of cheap electric power. A tunnel of less than 800 feet in length would furnish ample outlet for an intake that would develop hundreds of thousands of horse power, and all the necessary works could be constructed at a very low cost compared with the extensive operations on the American side.

Several plans for utilizing the water power on the Canadian side have been suggested by different eminent engineers, and the accompanying illustrations represent one of the most original and interesting yet proposed. This scheme involves a tunnel, but is very much simpler and radically different in many respects from that which is now being developed on the other side of the river.

Fig. 3 showe the general location of the works and their position relative to the American tunel. Fig. 1 gives a very excellent idea of the whole scheme. A tunnel is constructed directly under the river near the falls, and water is taken in from the river above by large vertical pipes, and after passing through the turbines is discharged through a short canal out under the falls and thence into the river below. At the right hand corner of the same illustration is seen a more detailed view of this tunnel. Some idea of its size can be gained by comparing its diameter with the height of the men seen in the foreground. Large Ferranti dynamos, similar in construction to those now in use in the Ferranti station at London, are to be directly driven by powerful Pelton water wheels. The size of these units has not been definitely decided upon, but they will doubtless be very large. The immense traveling cranes which are seen will be used in moving machinery to the different parts of the tunnel. Fig. 2 shows a cross-section of the tunnel, and perhaps gives a better idea of the location of the various machines and the inlet and outlet. It will be seen that this scheme is really very simple.

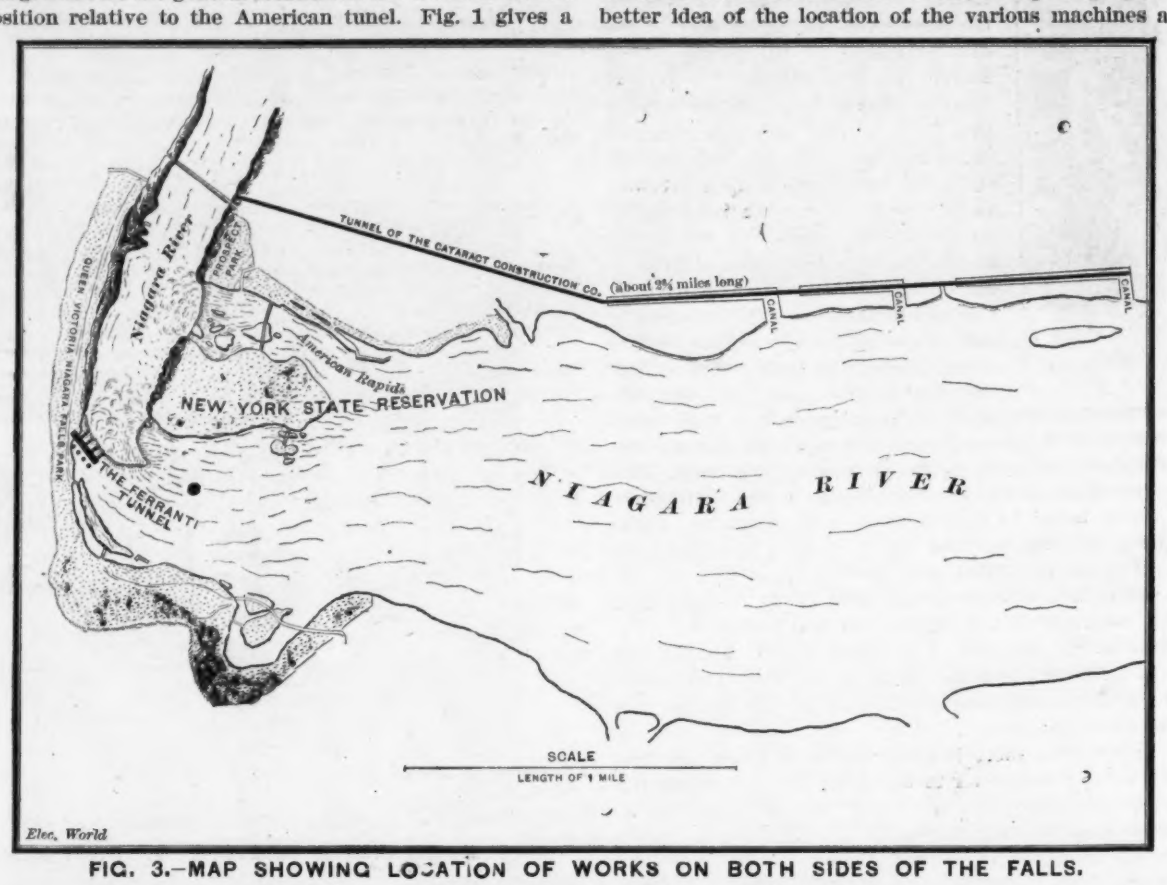


FIG. 3.—MAP SHOWING LOCATION OF WORKS ON BOTH SIDES OF THE FALLS.

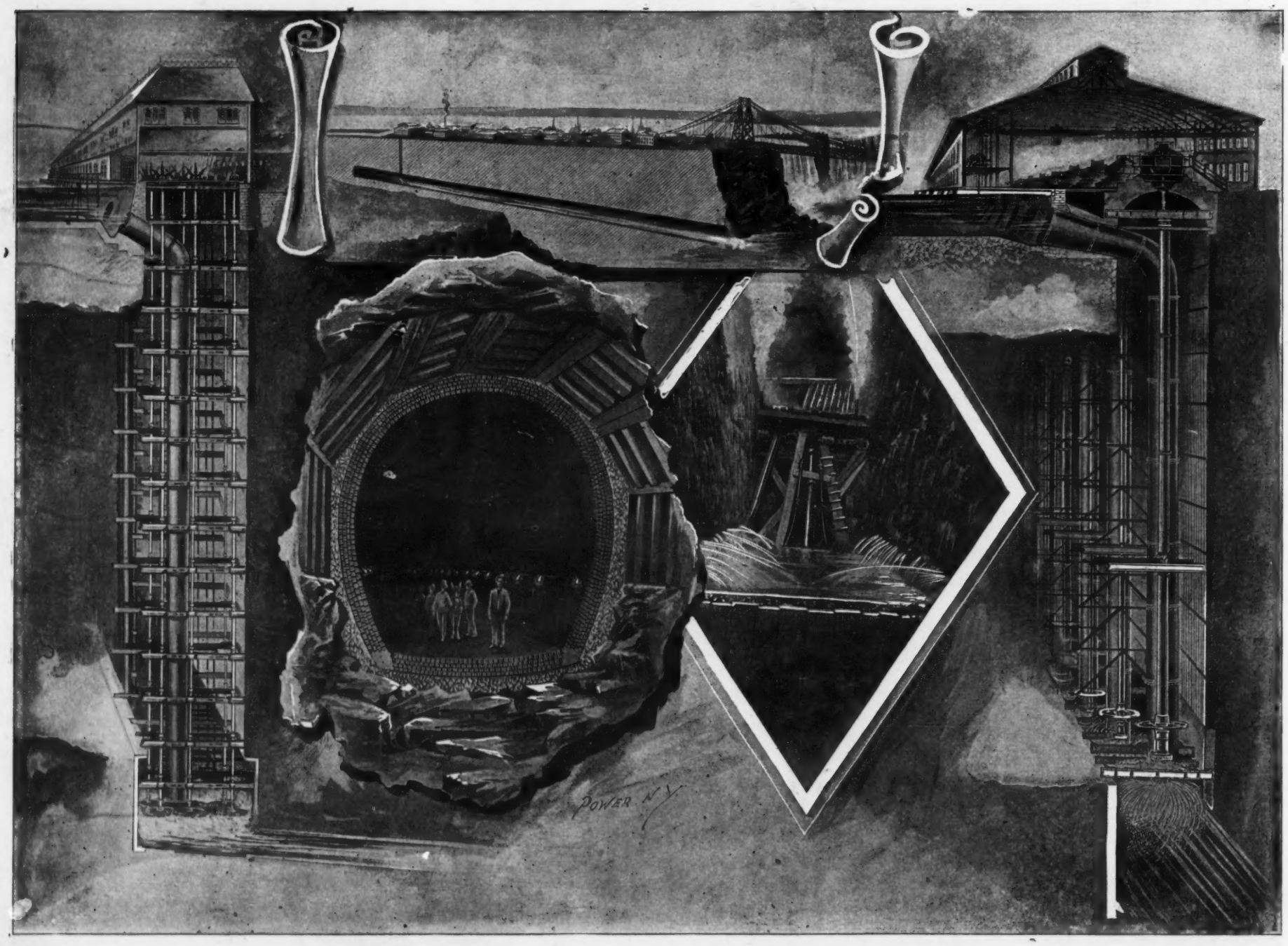


FIG. 4.—SHOWING PLAN FOR UTILIZING NIAGARA FALLS ON THE AMERICAN SIDE.

Prof. Forbes, of London, and the eminent engineer Ferranti have both given a great deal of study to the proposed works on the Canadian side of the falls. Those in the best position to judge expect to see work commenced some time in the spring under the management of the ablest engineers in this country and abroad.

Of the complete ultimate success of both undertakings there can be no question, and electricity will here play an important part in the solution of the great problem of securing the economical transmision of large powers.

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Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

FOURCROY (Antoine Francois de), an eminent French chemist, physician and author, who succeeded Macquer in the professorship at the Jardin du Roi, for which Lavoisier was likewise a candidate, publishes (vol. xxxix., p. 103, of the *Annales de Chimie*) the result of galvanic experiments which he made in conjunction with Louis Nicholas Vauquelin (1763–1829), and also with Baron Louis Jacques Thénard (1777–1857), who, in turn, became the successor of Fourcroy as professor of chemistry at the French Ecole Polytechnique. They thought that by using many discs they could increase the force of the current and also decompose water more rapidly. They found this was not, however, the case, and that with an enlarged pile the combustion of metallic wires was more rapid and brilliant, thus proving that the degree of combustion is relative to the surface of the plates. ("Encyclopædia Britannica," 1855, vol. xxi., p. 626.)

The grand experiment made conjointly by Fourcroy, Vauquelin and Seguin on the composition of water from its constituent gases was commenced May 13, 1790, and continued by them without intermission until its completion, nine days later. "The gases were fixed in a close vessel by means of electricity, and produced a nearly equal weight of water."[1]

Fourcroy was also one of the savans appointed in 1798 by the Academy of Sciences of Paris to examine and report upon the experiments of Galvani. The committee was composed of Guyton de Morveau, Coulomb, Vauquelin, Sabathier, Pelletan, Charles, Fourcroy and Hallé, the last named being charged with the verification of all the then recent discoveries, which were repeated with the assistance of Mr. de Humboldt, who went to Paris especially for the purpose. The official report fully indorsed and greatly praised the line of researches prosecuted by both Galvani and Humboldt, and the entire series of experiments was at once repeated by many of the leading physicists throughout Germany.

On June 19, 1803, one of Antoine Fourcroy's most interesting memoirs, treating of meteoric stones, was read by Mr. C. Fourcroy before the French Institute.[2]

A. D. 1801.——Lehot (C. J.), French physicist, sends a curious and lengthy memoir, regarding the circulation of a very subtile fluid in the galvanic chain, to the Institut National, before which body it is read on the 26 Frimaire, An IX.

To the analyzation of the above named memoir, Wilkinson devotes more than half the tenth chapter of his "Elements of Galvanism," calling attention to a very singular result from numerous experiments which is worthy of special mention. It is the possibility of distinguishing one metal from another without seeing or feeling either of them, and he says that by his arrangement of the chain, Mr. Lehot was able to recognize a portion of zinc from a piece of silver, at the extremity of a metallic thread several yards in length.

Lehot's contributions to the science of animal electricity are too numerous to be given here. Noad summarizes them in the following translation from pages 17, 18 of C. Matteucci's "Traité des phénomènes . . . ," Paris, 1844.

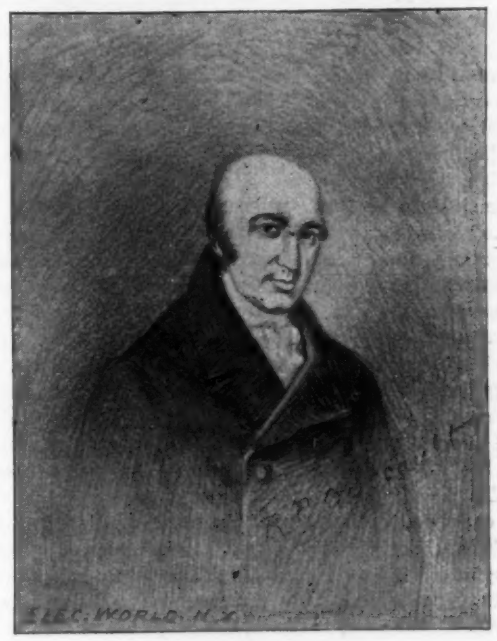
He ascertained that in a recently killed animal contractions are excited by the electric current in whatever direction it may be applied, but, when the vitality of the animal has become diminished, if the current be sent in the direction of the ramifications of the nerve, contractions are excited only at the commencement of the current; he contrary takes places when the current is directed contrary to the ramifications of the nerve; *i. e.*, in this case the contractions only take place when the current ceases. After studying the sensation excited by the current on the organs of taste, Lehot arrived at a most important result: the current which traverses a nerve in the direction of its ramifications excites a sensation when it ceases to pass, though this influence is only exerted at the commencement of its passage when the nerve is traversed in a direction contrary to its ramifications: the later experiments of Carlo Francesco, Bellingeri and Stefano Giovanni Marianini entirely confirm those of Lehot.[3]

A. D. 1801.——Wollaston (William Hyde), celebrated English chemist and natural philosopher, and an associate of Sir Humphry Davy, who had taken the degree of M. D., and joined the Royal Society in 1793, but soon abandoned the practice of medicine to devote himself exclusively to scientific researches, is the first to demonstrate the identity of galvanism and frictional electricity, through a paper read before the above named society in June, 1801.

The latter communication shows that he has succeeded in decomposing water as rapidly by means of mere sparks from frictional electricity as by the agency of the voltaic pile, and in a more tranquil and progressive manner than can be afforded through shocks from the large and powerful apparatus hitherto used. He had concluded that the decomposition must depend upon duly proportioning the strength of the charge to the quantity of water, and that the quantity exposed to its action at the surface of communication depends on the extent of that surface. He observes:

> Having procured a small wire of fine gold, and given to it as fine a point as I could, I inserted it into a capillary glass tube, and after having heated the tube so as to make it adhere to the point and cover it at every part, I gradually ground it down till, with a pocket lens, I could discern that the point of gold was disclosed. I coated several wires in this manner, and found that when sparks from a conductor were made to pass through water by means of a point so guarded, a spark passing to the distance of ⅛ of an inch would decompose water, when the point did not exceed 1-700 of an inch in diameter. With another point, which I estimated at 1-1500 a succession of sparks 1-20 of an inch in length afforded a current of small bubbles of air. With a still finer filament of gold, the wire current of electricity, without any perceptible sparks, evolved gas from water.

In his Bakerian lecture of Nov. 20, 1806, Sir Humphry Davy relates experiments made after the manner contrived by Wollaston, showing that the principle of action is the same in common as in voltaic electricity. Dr. Robert Hare, in a paper read before the Academy of Natural Sciences, "On the Objections to the Theories Severally of Franklin, Dufay and Ampère," etc., says that, instead of proving the identity of galvanism with frictional electricity, the above-named experiments show that in one characteristic at least there is a discordancy, but that at the same time they possibly "indicate that ethereal may give rise to ethereo-ponderable undulations." Noad remarks that in these ingenious experiments true electro-chemical decomposition was not effected; that is "the law which regulates the transference and the final place of the evolved



WILLIAM HYDE WOLLASTON.

bodies had no influence." The water was decomposed at both poles independently of each other, and the oxygen and hydrogen gases evolved at the wires are the elements of the water existing the instant before in those places. Faraday observes:

> That the poles, or rather points, have no mutual decomposing dependence, may be shown by substituting a wire or the finger for one of them, a change which does not at all interfere with the other, though it stops all action at the charged pole. This fact may be observed by turning the machine for some time; for though bubbles will rise from the point left unaltered in quantity sufficient to cover entirely the wire used for the other communication, if they could be applied to it, yet not a single bubble will appear on that wire.

Wollaston communicated a paper to the Royal Society (*Phil. Trans.*, vol. xci., p. 427) showing that the oxidation of the metal is the primary cause of the electrical phenomena obtained in the voltaic pile. The oxidizing power is finely shown by his eighth experiment, which he thus describes:

> Having colored a card with a strong infusion of litmus, I passed a current of electric sparks along it, by means of two fine gold points, touching it at the distance of an inch from each other. The effect, as in other cases, depending on the smallness of the quantity of water, was most discernible when the card was nearly dry. In this state a very few turns of the machine were sufficient to occasion a redness at the positive wire, very manifest to the naked eye. The negative wire, being afterward placed on the same spot, soon restored it to its original blue color.

He verified in 1802 the laws of double refraction in Iceland spar announced by Huygbens, and wrote a treatise thereon which was read before the Royal Society on the 24th of June, and contains additional evidence deduced from the superiority of Dr. Wollaston's mode of investigation.

He is said to have been the first to propose forming the spectrum by using a very narrow pencil of daylight instead of sunlight, and to have first made an accurate examination of the electric light. In his communication to the Philadelphia Transactions for 1802 he says:

> When the object viewed is a *blue* line of electric light, I have found the spectrum to be separated into several images; but the phenomena are somewhat different from the preceding (viz., the spectrum of the blue portion of the flame of a candle). It is, however, needless to describe minutely appearances which vary according to the brilliancy of the light, and which I cannot undertake to explain.

During the year 1815, Wollaston made a great improvement in the construction of voltaic batteries. Having observed that the power of a battery is much increased with a corresponding economy in zinc plates, when both surfaces of the latter are opposed to a surface of copper, he devised what he called an elementary galvanic battery. Each couple of the latter is merely made up of a plate of copper doubled up around a zinc plate from which it is kept apart by strips of cork or wood. The connecting trips of metal are attached to a wooden rod which is lowered or elevated when the battery is in or out of action. He found that a single plate of zinc, one inch square, when rightly mounted, was more than sufficient to ignite a wire of platina $\frac{1}{1000}$ of an inch in diameter, even when the acid is very diluted (fifty parts of water to one of sulphuric acid).

He was a very careful workman and observer, and made little of general theories unless supported by the most methodical experiments and minute investigations. It is said that, in order to adapt his apparatus to the popular uses, he generally endeavored to construct them upon the most reduced scale (*dans des proportions très exigues*). He produced wire of the platinum so extremely fine as to be almost imperceptible to the naked eyes. It was estimated that 30,000 pieces of his wire, placed side by side in contact, would not cover more than an inch, and that it would take 150 pieces of this wire bound together to form a thread as thick as a filament of raw silk. Although platinum is the heaviest of the known bodies, a mile of this wire would not weigh more than a grain. It may be well to add here that the wires lately made with John Wennstrom's sapphire plates, for delicate electrical apparatus, is so fine that 36 miles of it properly insulated for government use in torpedo experiments measures only about five inches in length by three in diameter when wound upon a spool. The fibre used as carbon filaments in the incandescent lamps is scraped to an even thinness by being drawn through sapphire plates from 30-1,000 to 4-1,000 of an inch in diameter. The smallest battery that Wollaston formed of the above described construction consisted of a thimble without its top, flattened until its opposite sides were about two-tenths of an inch asunder. The bottom part was then nearly one inch wide, and the top about three-tenths, and as its length did not exceed nine-tenths of an inch, the plate of zinc to be inserted was less than three-fourths of an inch square.[4]

We are also indebted to Dr. Wollaston for the first idea of the possibility of producing electromagnetic rotations; for, considering that the conducting wire acted differently according to the side which was presented to the magnet, that which was attracted by one side being repelled by the other, and that if this influence was produced by the impulse of a fluid that fluid must be continually circulating round the wire in a description of vortex of which the wire was the axis, he conceived that the consequence of such a *vertiginous* motion in the supposed electric or magnetic fluid would necessarily develop rotatory motion in the constituent parts of certain arrangements of magnets and conducting wires. Dr. Wollaston's own experiments (August, 1820) in support of these notions were not successful, and Prof. Schweigger opposed the action of revolving magnetism upon the ground that if it were true, a magnet might be made to revolve around the uniting wire, but Faraday found experimentally not only that a magnet could be made to revolve round the uniting wire, but that a movable uniting wire might be made to revolve around a magnet."[5]

Wollaston was made secretary of the Royal Society in 1806, became its president in 1820 after the death of Sir Joseph Banks, and contributed in all thirty-eight memoirs to the *Philosophical Transactions* of that institution.

His death occurred Dec. 22, 1828, and during the following February Dr. Fitton, president of the Geological Society, concluded his annual address with the following encomium:

> It would be difficult to name a man who so well combined the qualities of an English gentlemen and a philosopher, or whose life better deserves the eulogium given by the first of our orators to one of our most distinguished public characters; for it was marked by a constant wish and endeavor to be useful to mankind.[6]

A. D. 1802.——Walker (Adam), English writer and inventor of several very ingenious mathematical instruments, publishes in London his enlarged edition of "A System of Familiar Philosophy," two volumes, 8vo, in which he devotes sections v.-ix. of lecture ii., vol. i., to magnetism, and all of lectures vii. and viii. of the second volume to electricity.

We are informed, through his preface, that "the identity of fire, light, heat, caloric, phlogiston and electricity, or rather their being but modifications of one and the same principle, as well as their being the grand agents in the order of nature . . . are the leading problems of the work." In another part he tells us:

> If electricity, light and fire be but modifications of one and the same principle . . . and they have their origin or foundation in the sun, it is natural to suppose, in issuing from that luminary, they proceed from him first in their purest state, or in the character of electricity; that joining the particles of our atmosphere, electricity becomes *light*, and uniting with the grosser earth, *fire* . . . that this *fire* shall be culinary when called forth from the earth by ordinary *combustion*, and electric when called forth by *friction*. Thus have I exhibited this wonderful agent in most of the lights in which it has yet been seen; and flatter myself the reader's deductions from these appearances will be sim-

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[1] See *Trans. Amer. Phil. Soc.*, N. S., vol. vi., p. 339, giving description of apparatus for the decomposition and recomposition of water.

[2] See *Phil. Mag.*, vol. xvi., p. 293; Noad's "Lectures," p. 183, 184; Ure, "Dict. of Chem.;" also the interesting biography embracing a list of his very numerous works and treatises, at pages 818-819, vol. ix., of 1855, "Encyclopædia Britannica." See, likewise, "Royal Society Catalogue of Scientific Papers," vol. ii., pp. 677-682; Thomas Thomson, "History of Royal Society," p. 454; Wilkinson's "Elements of Galvanism. . . ." 1804, vol. ii., pp. 113, 145, 151, 152, 208, 359; Fahie's "History of Electric Telegraphy," p. 194; Izarn, "Manuel du Galv.," 1804, sec. 4, p. 167.

[3] See *Annales de Chimie*, vol. xxxviii., p. 42; *Journal de Physique*, An IX., Pluviose, lii., 135; Gilbert, *Annalen*, IX., 188; P. Sue, ainé, "Hist. du Galvanisme," vol. ii., pp. 123, 124, 129, 132, 141, 42; "Encyclopedia Metropole," vol. iv. (Electro-Magnetism, p. 84).

[4] *Annals of Philosophy*, vol. vi., p. 210.

[5] See Faraday's "Experimental Researches," vol. ii., pp. 159-162 for "Historical Statement Respecting Electromagnetic Rotation."

[6] *Phil. Mag. or Annals*, vol. v., p. 444. See also "The Roll Call of the Royal College of Physicians of London," by William Munk, M. D., vol. ii.; *Edin. Phil. Jour.*, vol. x., p. 183; Gmelin's "Chemistry," vol. i., p. 424; De la Rive, "Treatise on Electricity," pp. 444, 445; *Phil. Mag.*, vol. xxxiii., p. 488; lxiii., p. 15; James Napier, "Manual of Electro-Metallurgy," 4th Am. Ed., pp. 492, 518; Desbordeaux, in *Comptes Rendus*, vol. xix., p. 273; *Le Moniteur*, No. xl., for 1806; Sue, ainé, "Galvanisme," vol. ii., pp. 193-195, 199, 202; Joseph Izarn, "Manuel du Galvanisme," p. 137; *Poggendorff*, vol. ii., p. 1,362, "Encycl. Metrop.," vol. iv. (Galvanism), pp. 180, 181, 216, 222; *Nicholson's Journal*, vol. v., p. 332; Thos. Young, "Lectures," London, 1807, vol ii., p. 679; W. Sturgeon, "Scientific Researches," Bury, 1850, p. 29; *Quarterly Journal of Science* for January, 1821; *British Quarterly Review* for August, 1846; "Biog. Générale," tome xlvi., p. 822; Highton's "Electric Telegraph," p. 14; Larousse, "Dic. Universel," tome xv., p. 1,370.

ilar to my own, viz., that electricity emanates in a perfect state from the sun and fixed stars; that its particles repel each other and fill all space; that they have an affinity to the earth and planets, but an affinity that cannot easily be gratified, because the surrounding atmospheres are in part non-conductors, being already saturated, and of course repellent of the electric fluid.[7]

In the section devoted to "Miscellaneous Observations" he observes that the magnetic power may almost be said to be created by friction, rather than be communicated by it; for a magnet requires strength by giving magnetism to iron, so that if all the magnets in the world were lost, magnetism might be revived by rubbing the end of one steel bar against the side of another.

Section v., treating of "Magnetic Attraction," concludes as follows:

How far those observations and experiments go to establish the doctrine of a magnetic effluvium flowing through the earth, or from one end of a magnet to the other must be left to the reader's judgment and opinion. We are apt to laugh at the *subtil matter* of Descartes, and the *æther* of Euler, as occult qualities, which modern philosophy will not admit into its creed, but this effluvium is a *subtil matter*, an *æther*, equally as inexplicable, and as equally out of the reach of our five senses to scrutinize; however, if we may venture to guess at causes by effects, and to compare analogies with what we can see, feel, etc., I think we have infinite data in favor of an electromagnetic fluid, superior to any proof that can be brought of *æther* being the cause of gravity, light, vision, etc.

Mr. John Read's letter to the author relative to the *electrophorus* appears at pp. 47–49 of the second volume.[8]

A, D. 1802.——Alexandre (Jean), who is said to have been the natural son of Jean Jacques Rousseau, and to have studied for the medical profession, operates his secret telegraph (*télégraphe intime*) at Poitiers, and afterward addresses Mr. Chaptal, Ministre de l'Intérieur, asking for financial assistance, in order to go to Paris and submit his invention to the French government. This request being refused, by reason of Alexandre's unwillingness to divulge his secret, he next succeeded in obtaining the audience of Mr. Cochon, Prefect of Vienne, before whom he demonstrated his invention so successfully that the latter was induced to make a report of it to Mr. Chaptal, counseling him to invite Alexandre to Paris at the expense of the State. A second refusal was the result, and Alexandre then went to Tours, where he failed to obtain the desired assistance, although he there gave successful exhibitions of his telegraph before the Prefect of Indre-et-Loire, Gen. Pommereul, as well as in the presence of the Mayor and city officials.

The substance of Mr. Cochon's communication is to be found translated at pp. 111–113 of Fahie's "History of Electric Telegraphy," which latter also contains a full translation of the report addressed by the celebrated French astronomer, J. B J. Delambre, to the First Consul, suggesting an interview for the inventor's representative, Mr. Beauvais, which Bonaparte, however, refused to grant.

Alexandre died, 1832–1833, without having revealed his secret to any one but Mr. Beauvais. It is stated by Fahie that in the English *Chronicle* of June 19–22, 1802, appears a brief account of the above named exhibition given at Tours, concluding as follows: "The art or mechanism by which this is effected is unknown, but the inventor says that he can extend it to the distance of four or five leagues, even though a river should be interposed." A copy of the above newspaper, doubtless unique, is in Mr. Latimer Clark's library.[9]

A. D. 1802.——Sue (Pierre ainé), a very able French physician, publishes at Paris, "Histoire du Galvanism et analyse des différents ouvrages publiés sur cette découverte . . . ", which is considered by scientists one of the most important works upon the subject.[10]

The Problems of Commercial Electrolysis. IV.*

BY J. SWINBURNE.

MISCELLANEOUS PROCESSES.

Under this head I have classed a few electrolytic processes whose theory is obscure, and about whose practical success there may be some doubt.

Mr. Webster has brought out an electrolytic sewage process. The effluent has electricity passed through it, and this is said to separate the solid material completely, and kill all germs. Of course, when any sewage containing salt is electrolyzed, it produces chlorine or hypochlorites, and these would act on organic mater. Hermite, for instance, has applied his process to the disinfection of ships. This does not seem to be the basis of Webster's process, however, and there seems uncertainty as to what the action is supposed to be, and why the solid particles should be influenced by the current.

The next process is aging wine and spirits by means of the electric current. Whether there is really anything in this I do not know. Various inventors have brought out methods of aging liquors by electrolysis. There is uncertainty as to whether the result is produced, and as to how it is produced. Various deleterious alcohols might be oxidized into ethers, but it is strange that electricity should select just those that give a taste which is unpleasant to the human palate. Mr. Turell uses a direct, while M. de Meritens employs an alternating current.

The sterilization of milk by electrolysis is another process which is somewhat obscure.

THE ELECTRIC FURNACE.

The idea of using the heat of the arc for producing high temperatures for such purposes as melting iridium is about half a century old. Recently, however, we have had the Cowles furnace, used especially for the reduction of alumina. Properly speaking, this does not come within the scope of this paper, as there is no reason to suppose that electrolysis has anything to do with the reduction of the oxide. By pouring the power from a large dynamo into a carbon resistance, closed in so that the heat cannot readily escape, a very high temperature is produced. Alumina is then reduced by the hot carbon. It may be taken that at lower temperatures, such as those produced by ordinary furnaces, the affinity of aluminium for oxygen is greater than that of carbon, and that at the higher temperature the reverse is the case. It is not impossible, however, that the carbon in an ordinary furnace is inactive merely because it cannot get into good contact with solid alumina, and that in the Cowles furnace the alumina melts. In any case, there is no reason to suppose there is any electrolytic action.

The Cowles furnace is applicable to all processes which demand very high temperature, such as the reduction of oxides of aluminium, magnesium, calcium, barium, strontium, silicon, chromium, boron, tungsten, and manganese. Of course, many of these metals are not at present in demand; but then, it must be remembered, that may be because there has, until now, been no way of making them reasonably cheap. Many, if not all, of these metals have been obtained by the Cowles process.

It is a question of economy whether the Cowles furnace should not be employed in many other reduction processes which do not require such high temperatures. The furnace is efficient, as the heat is applied where it is wanted, and little is wasted by radiation or convection. We thus have to compare an ordinary furnace in which the heat is applied badly, and a great deal is wasted because the gases go off at a very high temperature, with a system with begins with an efficient furnace working a very inefficient heat engine and an efficient electrical machine. The electrical furnace will doubtless soon be applied in many cases, especially those which ordinarily involve inefficient furnaces, and retorts which break down quickly or leak.

The manufacture of phosphorus is a good example. On paper the process is simple. Bone ash, or tricalcic phosphate, is not reduced by carbon at ordinary furnace temperatures, so it is treated with sulphuric acid, and converted into monocalcic, or superphosphate. Making this involves making sulphuric acid, or buying it. Acid phosphate is then heated in retorts with carbon, and two-thirds of the phosphorus is obtainable theoretically. If sand is used it acts as a strong acid—or, rather, anhydride—at high temperatures, and all the phosphorus should be obtainable. The retorts, of course, give rise to trouble and expense. Messrs. Readman, Parker & Robinson, by employing the electric furnace, can deal with mineral phosphates, and require no sulphuric acid. I do not know whether carbon at the temperature attained in the electric furnace will reduce calcium phosphate to calcium and phosphorus, or whether calcium phosphide is formed. With sand, of course, calcium silicate is formed. One might expect that this would be reduced to calcium and silicon, in which case it would be reasonable to suppose that the operation could be carried on without silica. It has been said that some oxides which can be reduced by very hot carbon when dealt with separately, can form compounds that cannot be reduced if one oxide is strongly acid in comparison with the other. If that is the case, though the lime and silica might be reducible separately, the combination of the two, calcium silicate, might be irreducible. Whether calcium silicate is reducible or not, silica must, of course, be employed if the phosphate would otherwise be converted into phosphide.

It would be well to see what other reduction processes could be dealt with economically by the Cowles furnace. Doubtless there are many, and Messrs. Parker & Robinson are sure to explore the field pretty thoroughly.

CONCLUSION.

A very few of the possible applications of electrolysis have been described in the foregoing paper, and the labors of many workers have been passed without mention. This was unavoidable. There is also another difficulty in writing such a paper as this: I have not worked at all the processes myself, and have had to rely on published acounts in many cases. Out of every hundred new inventions in electrometallurgy, ninety are impossible chemically or electrically. If I have ruthlessly cut out a possible or admitted an impossible process, I must ask pardon on account of the impossibility of trying all the processes myself, even experimentally, and must plead that I have been as skeptical as possible.

There are other directions in which electrolysis may play an important part. The improvement of the manufacture of white lead deserves the most careful attention. The Dutch process is unhealthy, costly and barbarous. The electrolytic manufacture of aniline dyes has received considerable attention. Dr. Goppelsroeder has done a good deal of work in this direction, and samples of silks dyed by electrolytically prepared colors were shown both in the Paris and the Frankfort electrical exhibitions. The extraction of gold from sea water, which is said to contain minute quantities, need hardly be treated seriously. Even if it were possible, such a process would be of no use. All improved processes for obtaining precious metals merely enrich some at the expense of others, and reduce the value of the metals. Obtaining gold more easily would be no good to the community unless it became cheap enough to be used commercially.

Fire Risks and Rules in America.*

The subject of fire risks, insurance, and rules and regulations for wiring, turns up from time to time, and it is safe to say that on every occasion the result is a strengthening of confidence in electrical work. The insurance companies are beginning to bestir themselves in the United States, and a meeting of "electrical insurance experts" has been held for the purpose of discussing a uniform set of rules for electrical work. The subject of fire risks in electric lighting has been brought before the American offices on several occasions by other associations, but no spontaneous meeting of any importance appears to have been held by them. We understand that during 1889 there were 119 fires due to electrical causes in the whole of the United States, and that in the following year there were only 73. This decrease may be traced to two tendencies; one, of bad insulation to break down and thus by degrees wiping out bad work by conflagrations, and the other, of the natural improvement in the quality of materials and workmanship. The insulation consisting of cotton and white lead, known as underwriters' wire, was at one time very commonly employed in America, and owing to conditions of climate it sufficed for many purposes, and is, we believe, even now used with safety for some interior work, although it was unanimously condemned at a meeting of representatives of the Edison companies in 1887. This trust in the dryness of the climate has, however, led to serious accidents, and, jumping from the frying-pan into the fire, the non-inflammable non-waterproof insulation has, in some cases, been exchanged for a covering which will, indeed, resist damp, but, consisting chiefly of tar and wax, is highly combustible. There has been a great improvement of late both in the manfacture of insulated cables and wires in the United States, since several varieties are imported into this country, and some of them are found to satisfy the most stringent requirements.

We find the American journals teem with descriptions of improved contacts, switches, and other safety devices. Glancing through the last number of The Electrical World of New York we find a sufficient number of examples to show which way the wind is blowing. It is true that a wire covered with woven canvas is illustrated among the advertisements on the first page, but it is in company with four other advertisements, three of which claim high insulating qualities. The next two pages contain seven claims for mica, together with a china cut-out; further on is a patent insulating material, then hard rubber, slate for switchboards, then a relapse into wood rosettes and cleats; but soon after come porcelain insulators, porcelain base switch, weatherproof wire—whatever that may be—and porcelain lamp sockets. At the end of the paper we find more porcelain, kerite, mica, okonite, another porcelain cut-out, general porcelain fittings, special cut-out for motors, &c. So much for the advertisements, which may be taken as a fair guide of what is going on. In the body of the paper we find an article on tests of fireproof wire, a ceiling cut-out—apparently porcelain, a "bug" cut-out, improved insulator pin, a notice of an insulator company, a protest of the New York Board of Fire Underwriters against the trolley system. Among the patents are two safety switches, armature insulation, safety fuse, and a new insulator. This is a pretty good list for a single number taken at random, but to it we must add the announcement of the meeting of insurance experts to which we have already alluded, an article by Mr. G. Binswanger, on "How Fire Losses Are Prevented in England," and two editorial notes on the subject.

Mr. Binswanger begins by expressing surprise that the insurance companies in America charge a special premium for buildings in which electricity is used; but at the conclusion of a long letter devoted almost entirely to the praises of the Phoenix Office and its electrical inspector, he admits that the "fittings, such as switches, cut-outs, etc.," which he has received from America, "are so poor from an electrical point of view, according to our notion, that no inspector of central stations or fire officer would allow them to be used in England." The insurance offices in the two countries have taken very different courses of action with regard to electric lighting. Here regulations were imposed which were highly unpopular, not so much on account of stringency, but by reason of their vagueness and need for separate interpretation for each job, the interpretation often coming only after the work had been done. In America, on the other hand, the companies did nothing, but merely raised the premiums. One result was the establishment in May, 1890, of the Electrical Mutual Insurance Company, which provided for intelligent inspection. It took risks amounting to $2,897,587 last year, and did not incur the loss of a single dollar. When brought into competition with this company other offices reduced their premiums to one-half. The Fire Underwriters' Associa-

[7] Lecture viii., p. 72.
[8] See also *Poggendorff*, vol. ii., pp. 1,248, 1,949.
[9] See, *Annales Télégraphiques*, March-April 1859, pp. 188-199, for Mr. Edward Gerspach's Memoir; *Sci. Amer. Supplement*, No. 384, for a translation of Mr. Auguste Gueroult's article in *La Lumière Electrique*; M. Cézanne, "Le Cable Transatlantique." Paris, 1867. p. 32; M. Berio, "Ephemerides of the Lecture Society," Genoa, 1872, p. 645.
[10] See "Biographie Générale," vol. xliv., pp. 618, 619; Larousse, "Dictionnaire Universel," vol. 14, p. 1,200; Wilkinson "Elem. of Galv. . . . . " 1804, vol. i, p. 182.

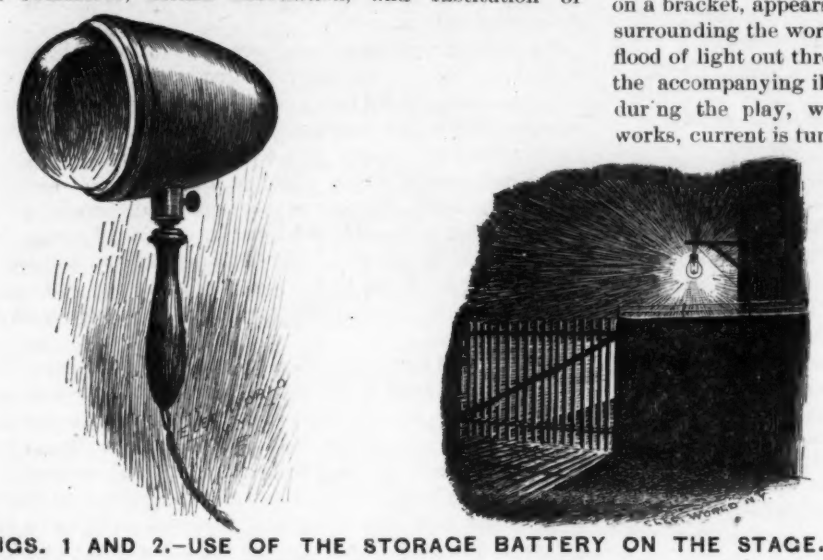
*Concluded. A paper read before the Institution of Electrical Engineers, London. For the first, second and third sections see THE ELECTRICAL WORLD of Sept. 3, 10 and 17, 1892.

*From *The Electrician*, London.

tion of Philadelphia insures more than 5,000 buildings supplied with electric light and power, and during last year there was not a single fire which could be attributed to electric wires. Under these circumstances, we can hardly agree with Mr. Binswanger in his general advice to the American nation. "In my opinion," he writes. "the best way to remove the difficulties of which you speak is to get an authority in America like Mr. Musgrave Heaphy."

Rules for insulation and proper erection of electric work have been considered by the National Electric Light Association, a body which appears to successfully combine the most useful features of our London Chamber of Commerce, British Association, and Institution of Electrical Engineers, but their attention has been directed chiefly to the protection of high-pressure, arc-light circuits. If the fire offices of the United States can agree upon a single set of rules, self-explanatory, and with intelligent specification of work and material, they will have done more than ours can accomplish.

The introduction of well-designed fittings is evidently making rapid progress in America without the assistance or compulsion of insurance offices, and they have makes of insulated wire which, if not up to the best qualities of our vulcanized rubber, are amply sufficient for all ordinary requirements, especially in a dry climate. From the editorial note in our contemporary we understand that the non-conformity of the rules, rather than their severity, is the present trouble. This is a smaller evil than the non-conformity in the interpretation of one important set of rules, which has caused so much annoyance with us. It seems under these circumstances that there is not much to complain of. Americans led the way in electric lighting at a pace which we did not care to follow, and now they are finding disadvantages of cheap and nasty work, and have already adopted many of the precautions which have been initiated on this side of the Atlantic for low-pressure work, and are at the same time improving the high-pressure arc circuits which have given rise to most of the accidents. By thus allowing matters to right themselves they seem to be taking the best possible course.



FIGS. 1 AND 2.—USE OF THE STORAGE BATTERY ON THE STAGE.

The Storage Battery on the Stage.

Electricity has played the prominent part in so many theatrical productions of late that its application for this purpose has ceased to excite the interest which it formerly did. The most recent thing in this line, however, is peculiar in that the storage battery is relied upon as the source of light instead of the ordinary street mains or the isolated plant, as has heretofore been the case. This application of the storage battery occurred in the presentation last week at Hammerstein's Theatre, 125th street, of a new play, the scene of which is laid at the Carnegie Works at Homestead during the recent strike.

A corner of the building, to which an arc lamp is swung on a bracket, appears partially concealed by the high fence surrounding the works. A powerful searchlight throws a flood of light out through the gate, as is shown in one of the accompanying illustrations (Fig. 2). At another time during the play, when an attack is expected upon the works, current is turned on to wires running along the top of the fence, which are quickly brought to a brilliant heat. The searchlight consists of a reflector over the mouth of which is placed a bull's eye, and contains a 114 c. p. lamp. It is held by a handle, as may be seen in Fig. 1. The arc lamp is of the Russell type, and is of 2,500 c. p., and it burns smoothly and brilliantly on the battery circuit. The current both for the searchlight and the arc light is furnished by 24 cells of the Franklin Electric Company's battery, having a total electromotive force of nearly 60 volts. These batteries were fully described in THE ELECTRICAL WORLD of July 30, 1892, and are $3\frac{1}{4} \times 4\frac{1}{2}$ inches in size and enclosed in a neat oak box, which occupies a space of only $22\frac{1}{2} \times 14\frac{1}{2} \times 6\frac{1}{2}$ inches. On the top of this case is a small rheostat and switch and eight binding posts. As the light is only required for about 15 minutes during each performance the batteries will run for eight performances without recharging. This whole equipment was devised by Mr. Frank Irving, of the Franklin Electric Company, 106 and 108 Liberty street, New York, and is a very compact and complete outfit. It possesses the advantage of being easily handled and can be conveniently carried by the company when on the road, and be used in theatres where current would otherwise be unavailable.

An Electric Street Sprinkler.

A very rapid and effective way of watering streets is shown in the accompanying illustration, which represents one of the cars of the United Tramway Sprinkling Company in actual operation, in Albany, N. Y. To all appearances this is an ordinary electric car, but in reality it is a huge iron tank filled with water. It is made in the form of a street car, in order that its appearance may be more ornamental, and that it may be less likely to frighten horses. A water pipe connected to the front end of the car extends out over the street and scatters the water over a large area. The pipe has a swinging joint, so that it can be turned back parallel to the car to allow the passing of carriages and teams, or in cases where the street is very narrow. The whole apparatus is under easy control, and works with more uniformity than the old style of sprinkler drawn by horses. As the car can carry a large quantity of water and move at a comparatively high rate of speed, it will undoubtedly prove very successful, and in time displace its more clumsy rival in cities and streets where electric lines are in operation.

AN ELECTRIC STREET SPRINKLER.

The Union Electric Company's Launch.

A new electric launch, recently brought out by the Union Electric Company, of 45 Broadway, New York City, made a very successful trial trip on the Hudson near Nyack last week. The boat easily glided along at the rate of eight miles an hour without the slightest jar or noise, and with nothing to indicate the method of propulsion. The Vashti, as the launch is called, is a very pretty craft and works as smoothly as could be desired.

The hull was built by Charles L. Seabury & Co., of Nyack, on the model of the launch of the ill-starred Alva. While not constructed on racing lines she is very graceful, as may be seen in Fig. 1, and unusually seaworthy and roomy. She measures 30 feet over all, with 6-foot 6-inch beam, and draws two feet of water. The frame is of oak with cedar planking, copper fastened, while the interior is finished in quartered oak and handsomely upholstered.

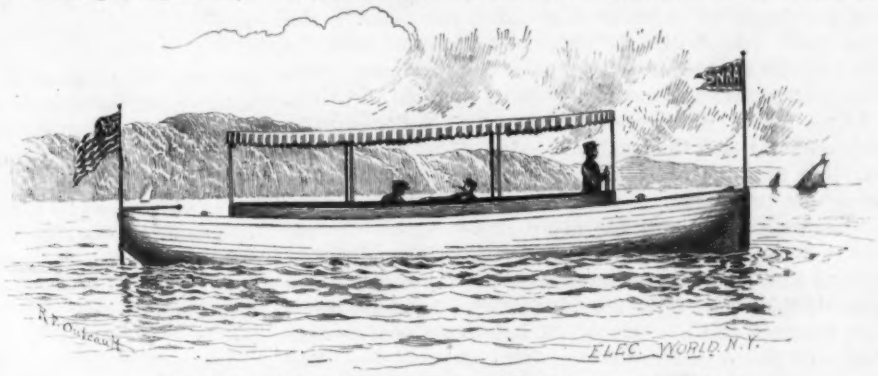


FIG. 1.—UNION ELECTRIC COMPANY'S LAUNCH.

The motive power consists of a Main motor driven by storage batteries. The storage cells are of the River and Rail type, this company being the parent of the Union Electric Company. Both the cell and the motor were fully described in The Electrical World of July 26, 1890.

The battery has been modified somewhat, however. The plates are now placed in a vertical position instead of horizontally, as was the case in the old River and Rail battery. The positive plates are made up of thin sheets of lead foil pressed together between lead plates, and the whole perforated and strongly riveted together. The negative plates are made of an amalgam of zinc and mercury deposited electrolytically upon a copper plate. These are placed in the ordinary solution of dilute sulphuric acid. The advantages claimed for this type of cell are that there is no active material to fall out and short circuit the cell, that it is impossible to buckle or injure them in any way by very heavy discharges, and that the use of zinc results in a considerably higher electromotive force than is obtained in the ordinary lead battery. The cells are very much more quickly formed than the ordinary type, which is sometimes an important point. The Vashti carries 80 cells, each composed of three double plates. The electromotive force of each battery is 2.4 volts and its capacity is 350 watt hours. The weight of the cell complete is 36 pounds. The cells are placed under the floor below the water line, where they serve as ballast and leave a clear cockpit 22 feet in length. In many electric launches the batteries are placed in the lockers under the transoms or seats, but in this case this valuable space is left free and can be used for storage room.

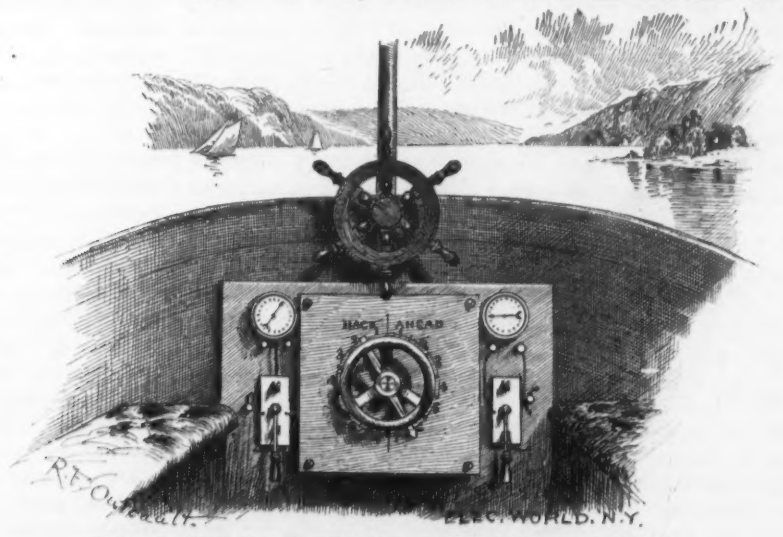


FIG. 2.—UNION ELECTRIC COMPANY'S LAUNCH.

The motor is the old River and Rail motor with a few modifications and improvements. It will be remembered that neither the armature nor the field revolves, so that there is no moving wire about it. The field core, together with the poles and brushes, is carried upon the shaft and revolves with it. It is a four-pole machine. Many advantages are claimed for this type, as the problem of insulation is a comparatively simple one, since all the

windings are stationary. One of the main points, however, is the slow speed which can be attained. In this case the motor is attached directly to the end of the shaft and revolves at a speed of only about 400 revolutions. A very ingenious device has been contrived by Prof. Main for maintaining the proper pressure upon the revolving carbon brushes, depending on centrifugal force.

The controlling mechanism of the launch is very simple and occupies but little room. It can be easily understood by reference to Fig. 2. The batteries are divided into two groups and controlled by the two switches which are seen to the right and left of the rheostat. The throwing down of either one of these switches places in circuit the corresponding half of the batteries, the whole being in circuit when both switches are down. The hand wheel on the front of the rheostat operates a double pole snap switch, and closes the circuit so as to drive the boat ahead or back, according as it is turned to the right or left. Seven different gradations of resistance regulate the speed from a very slow one up to the maximum of eight or nine miles per hour. The rheostat is placed directly under the wheel so that the boat can be controlled by the use of one hand only. The 80 cells furnish an electromotive force of about 200 volts, and the normal discharge rate when the launch is under full headway is in the neighborhood of 20 amperes, showing that approximately 5 h. p. is required to drive the launch at this speed.

The Vashti will run for about nine hours at full speed without recharging. She carries comfortably twenty-five persons, an unusually large number for a boat of this size. With the advantages of steady, noiseless running, the absence of all smoke or dirt, perfect ease of control, a clear sweep from stern to bow and good speed, this type of launch will undoubtedly find favor.

On A Magnetic Balance and Its Practical Use.*

BY DR. H. E. J. G. DU BOIS.

In a paper on "Magnetic Circuits and their Measurement," read to the Frankfort Electrical Congress in 1 91, the principles of a magnetic balance were explained, with which magnetic curves of any material might be readily obtained in absolute measure. It may be theoretically defined as an electromagnetic system of variable configuration, the reluctance of which always naturally tends toward a minimum; its variations, however, remaining exceedingly small. I now propose to describe the instrument exhibited to the Section.

It is the outcome of a year's evolution of constructive detail. By means of a gauge belonging to the instrument,

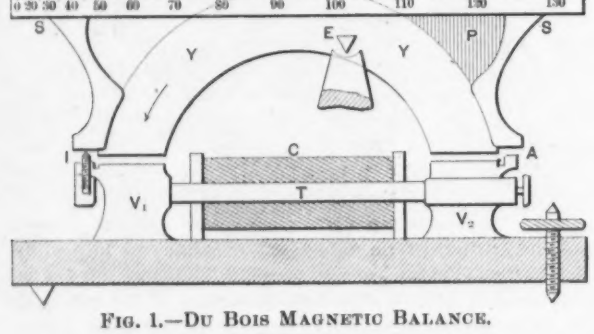


Fig. 1.—Du Bois Magnetic Balance.

one test piece T is cut to 15 cms. length and 1.128 cms. diameter, corresponding to 1 sq. cm. section; the latter need not necessarily be adhered to, if convenient, but has the advantage of obviating all further calculations, as will be seen below. The coil C is 4π cms. long† and wound with 100 turns; therefore, near the middle it gives a field = 10 × current (in ampères). It will carry currents up to 30 ampères, which may be conveniently measured by the usual ampère meters. The corresponding range of field (0 to 300 C. G. S.) is all that is wanted in the great majority

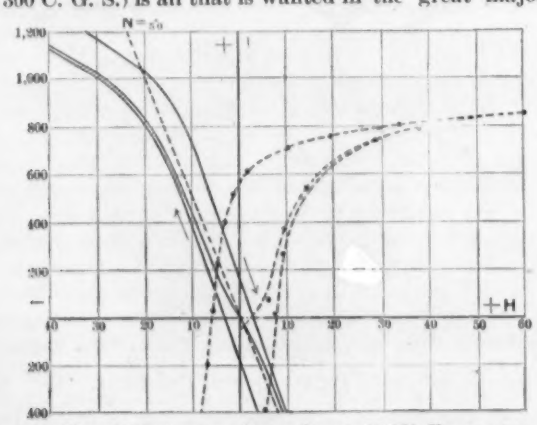


Fig. 2.—No. 7 Ordinary Cast Iron, 25,000 Ergs per Cu. Cm. Coerc. = 11.

of cases. The test piece is supported on two adjustable M plates, by means of which it may be readily set concentric to the coil, which is then slipped into position, the test piece being automatically clamped by the plunger in the upright V_2. Fig. 1 (a quarter of the natural size) shows the curved yoke Y Y of best Swedish iron playing over the stop A and screw I. The latter is enclosed in a cap after calibration, so that the adjustment cannot be interfered with. P is a lead counterweight.

I have made a series of observations to find, experimentally, what function of the magnetization of the test piece

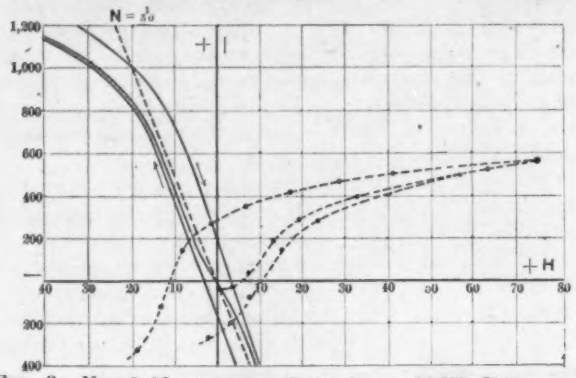


Fig. 3.—No. 6 Malleable Cast Iron. 24,600 Ergs per Cu. Cm. Coerc. = 7.

the resulting moment on the yoke (measured by compensating with the sliding weights) would prove to be. A small secondary was slipped over the middle of T and connected to a ballistic galvanometer. It was found that the resulting moment was accurately proportional to ^{2} (or $\mathbf{B}^2$ up to values of $\mathbf{I} = 1{,}300$ (or $\mathbf{B} = 1{,}600$), with a test piece of 1 centimetre section; this is all the range that is usually wanted; however, by using a somewhat thinner sample,

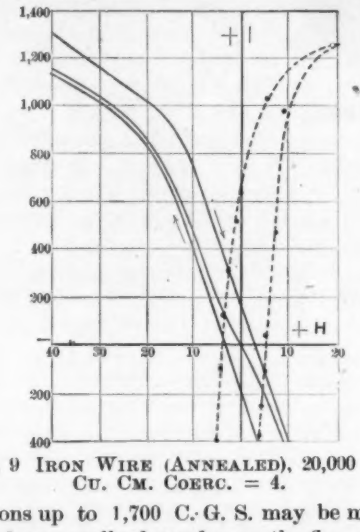


Fig. 4.—No. 9 Iron Wire (Annealed), 20,000 Ergs per Cu. Cm. Coerc. = 4.

magnetizations up to 1,700 C. G. S. may be measured, as the tractive forces really depend upon the flux of induction through the test piece only.

After this law had been experimentally established, it was evidently better to introduce a quadratic scale. Along this two mutually independent weights, W_{100} and W_4, slide, of 100 and 4 grammes weight respectively. Accordingly, the scale readings have only to be multiplied into the square roots of those weights, viz., 10 or 2, in order to obtain the absolute value of $\mathbf{I}$ in the sample. The smaller weight is used for the range of $0 < \mathbf{I} < 260$; it is then slid back to zero, and measurements continued with the larger weight for $260 < \mathbf{I} < 1{,}300$. The instrument does not indicate whether one is to take $+\sqrt{\mathbf{I}}$ or $-\sqrt{\mathbf{I}}$: but on plotting the results this becomes at once evident, one of the two points falling entirely outside the smooth curve representing the observations; it is therefore unnecessary to add a special permanently polarized arrangement with which to detect the direction of magnetization.

The demagnetizing factor N for a cylinder of dimensional ratio (length/diameter) 15 is about 0.12,‡ it is found in the balance to be reduced to 0.02, corresponding to the three fold ratio 45. This number was found by plotting the curve of a standard sample directly from the balance, and shearing it backward into coincidence with the normal curve obtained with a ring of the same material. The result was, moreover, arrived at that the usual rectilinear pseudo-axis of ordinates would do well enough up to half the saturation value; but that on the whole it was more accurate to introduce a generalized curvilinear shearing base. This may be called an instrumental directrix, as it remains characteristic of the instrument when once determined by means of a standard sample; all the corrections due to the uprights V_1 and O_2, the yoke Y Y, the air spaces with their variable leakages, etc., are combined in it; it is used when ordinary unlooped curves of ascending reversals are being taken. In order also to correct for hysteresis of instrumental parts of the magnetic circuit, it is advisable to introduce two other directrices, the horizontal distance of which measures the coercive force of the apparatus. The left one is used for plotting ascending curves, the right one for the descending branches.

In conclusion, I may offer a few remarks on the practical use of the magnetic balance. The coil is placed in circuit with a reversing key, a good ampère meter, one or two storage cells and rheostats (preferably liquid), so as to admit of easily and gradually reversing, varying and reading the current between 0 and 30 ampères. In the first place, everything should be thoroughly demagnetized by diminishing reversals; accordingly, the yoke is slowly lifted by an arrangement provided for the purpose, while the reversing key is being quickly worked; it ought to remain in the lifted position when the instrument is not used, in order to spare the knife edges E. Then the coil is moved toward the observer and the test piece gradually pulled out, reversing all the time.

The method of taking readings will be sufficiently obvious from the above description; I will only add that on account of magnetic instability the position of the sliding weight is determined, which will just pull the left hand stop off the screw I. It has been found an unnecessary complication to introduce a secondary bell or telephone circuit as a criterion for the breaking of contact. The observer's ears and fingers afford a readier means, and after some little practice different observers always find exactly the same reading to one or two tenths of a scale division (corresponding to a unit of magnetization); this is more than sufficiently accurate.

The tenfold ampère and scale readings (or with the small weight only double the latter) directly give abscissæ and ordinates respectively in C. G. S. units. The former are measured from the instrumental directrices as explained above; these are drawn on a transparent card belonging to the instrument, which is laid on the upper left hand or lower right hand quadrant of the squared paper, the plotting on which is thereby rendered as simple as when the usual method is followed. If the section of the test piece is not 1 sq. cm., it has to be measured, and the ordinates have still to be divided by it *after* the above process of plotting.

These dotted curves of Figs. 2, 3 and 4 were obtained with actual samples in the instrument exhibited. The full drawn lines are the directrices; the middle one for ascending reversals is seen to considerably deviate from the straight line corresponding to $\mathbf{N} = 0.02$ as the magnetization increases beyond 850. From the malleable iron curve (Fig. 4), the first given for this material so far as I am aware, it may be inferred that its magnetization (for $\mathbf{H} = 65$) is about 50 per cent. greater, and its coercive force as much less than those of ordinary cast iron. Fig. 5 was obtained with a bundle of 124 thin iron wires, presenting a total cross section of 1 sq. cm.

Electro-Metallurgy.—XIV.*

BY F. M. F. CAZIN.

In Fig. 3, plan; Fig. 4, longitudinal section: Fig. 5, transverse section, on page 180 the following letters indicate the objects marked therewith as follows: *A* signifies anodes; *b* signifies cathodes; *c* signifies the (0.03 m. diameter) conductors for anodes; *d* signifies strips of copper sheet to make electric connections for anodes; *e* signifies the conductor (of 0.03 m. diameter) for cathodes; *f* signifies the strips of copper sheet to make electric connections for cathodes; *g* signifies wooden bars, between which the electrodes are inserted; *h* signifies the wooden bars on which the anodes rest, which bars are inserted in bearings cut into the planks (*i*) serving as their supports; *k* signifies the feed pipe for circulating the electrolyte; *l* signifies the discharge pipe for the same purpose; *m* signifies a trough for distributing the circulating electrolyte in proper proportions over the entire bath; *o* signifies the clamp screws for making electric connection; *x-y* signifies in Fig. 4 the level to which the electrolyte is permitted to fill the vat. In Fig. 2 (p. 179) *K* signifies the cathodes suspended by copper strips (*C* and *D*) from wooden bars (*Q*) inserted in bearings cut into wooden bars (*Z*) supporting *Q*, *Q*; *L* signifies the main electric conductor connected with the bent strips *C* and *D*.

Electrolytic refining must always constitute the most important part in any electrolytic copper production process. The ore extraction part of the process may eventually be of an exclusively chemical nature, or it may involve another either independent or simultaneous electrolytic reaction, by the instrumentality of which the extracting solvent to be applied to the ores is procured. But the manipulations of copper refining and of copper production by the use of electrolysis are so closely connected in actual practice, and exercise such influence on one another in the selection of methods and of apparatus, that a consideration of one isolated from the other would more complicate than facilitate matters.

Therefore, in describing apparatus employed for electrolytic refining the consideration of methods of extraction of ores and the influence exercised thereby on the selection and construction of such apparatus cannot be avoided or excluded, and electrolytic production of copper must be made a part also of the discussion.

If the German metallurgists at Ocher in the Hartz Mountains had with the extremely valuable and important assistance of the firm of Siemens & Halske, of Berlin, set agoing the pioneer establishment for electrolytic copper refining, it was Eugenio Marchese who first succeeded in the electrolytic production of copper from its ores. If for economical reasons he directed his main activity later on toward the refining directly from so impure products of copper smelting as had not previously been considered available for electrolytic refining, he only concentrated endeavors and activity on that part of his scheme that offered the greatest amount of practical difficulties, leaving the chemical part of the production in general to other competent hands that were soon found and proposed a variety of processes of more or less merit.

And yet neither the metallurgists at Ocher nor Marchese have a claim to first invention, but to first practical execu-

* A paper read before the British Association, Section A, Edinburgh, August, 1892.

† Really, it is slightly shorter (12.2 cms.) to compensate the end effects.

‡ See the table in my "Mathematical Theory of Ferro-Magnetism," *Wied. Ann.* xlvi., 1892, p. 496.

* For the thirteenth section of this article see THE ELECTRICAL WORLD of Sept. 17, 1892.

Corrections on page 123 of Aug. 23, first column, eleventh line of footnote; read "Moebius" instead of "Mochin's."

On page 151, first column of Sept. 3, the third last equation from foot of page read

$$E = \frac{C n^3}{n} \times \frac{R}{n^2}$$

and same page and column third line from below read $\frac{1}{n^2}$ instead of $\frac{1}{n}$.

tion only. On Nov. 1, 1877, a patent of the German Empire was issued to Emil Andre, of Ehrenbreitstein on the Rhine, for the obtaining of metals and metal alloys by electrolysis, and his description, which is made part of his claims, details in four chapters a variety of methods for electrolytic metal refining, a peculiar and, up to date, not practiced feature of which consists in the use of what virtually constitutes two cathodes in succession with one soluble anode, the first cathode having open spaces, for the passage of the electrolyte; the purpose being to precipitate silver on the first and copper on the second cathode. His claims would cover all methods now practiced, were they less general and more specific.

His description also contains suggestions in relation to the treatment of nickel-iron ores (without copper), such as they have only lately become the subject of mining and metallurgical treatment at Sudbury, Canada; and, strange to contemplate. Andre has mentioned already horizontal or even inclined electrodes. Indeed would his four descriptions even at this date furnish ideas for a gross of new United States patents, so extensive and original are they.

The description made by E. Marchese in his different applications, dated five years later, for method patent of his copper production contains, as the one of Andre does, some errors relating to the chemical relations, and constitutes, the same as Andre's, an endeavor to cover by patent a great deal more than the applicant could possibly claim as his own invention, and betrays a tendency that prevails with all patent applicants in matters of electrolysis up to the present date of securing as much as possible by patent of what to the scientists forms the common stock of information. Both applications relate to all sulphides and chlorides of any or all metals and to their electrolytic treatment in any kind of apparatus. It thus happens that the claims granted to them would cover almost the entire field of copper electrolysis, even the galvanic cell known for over half a century before the names of either Andre or Eng., to Marchese appeared before the public. But the claims granted in Europe, 6,048, Nov. 1, 1877, to Andre and 22, 429, May 2, 1882, D. R. P. 12,725, Sept. 23, 1884, Engl. to Marchese, are in such general and indefinite terms that they would form a fragile foundation for claiming damages for infringement, even were they extended to the United States, as to the best of my knowledge they are not.

Marchese's real merit consists in having set up metallurgical schemes for separating copper from its compounds as

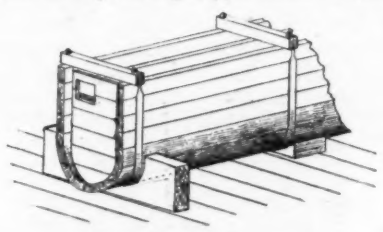


FIG. 1.

they occur in natural crude ores, in which schemes for the first time electrolysis took its place, and in having carried out some of these schemes and specially the refining part thereof with practical success, notwithstanding the drawback experienced in the attempt to carry out some others of these schemes, they having been found faulty and impracticable, and notwithstanding the fact that of the enormous expectations that were created by himself, neither all nor even any could be realized in full. At all events, to him is due the honor of first successfully refining copper from very impure and inferior anodes.

Crowned with practical success before all others has the process been, which has been described in these pages (on p. 91 of Vol. XX., No. 6), as "second method," and which grew entirely out of Marchese's experiments; and the apparatus shown in the preceding article is such as has been employed in the practical carrying out of this method.

As the illustrations on the preceding pages plainly show, Marchese employs cathodes and anodes entirely independent the ones from the others. It is this system followed by Eugenio Marchese of employing independent electrodes, to which the word "multiple" has been illogically applied, and which more properly bears Marchese's name.

Actual practice resulted in many mishaps to the earlier endeavors. These mishaps had their causes in the different parts and details of the apparatus employed as well as in some erroneous ideas as to the nature of the chemical reactions that took place in electrolysis.

For all the mishaps and setbacks, adequate remedies had to be applied before a practical and uniform success could be secured.

As the practical development of the art was intentionally surrounded with secrecy, it is in the common nature of things that the outside world had but exaggerated reports of mishaps occurring, and even at the present date, not only the public but professionals also maintain opinions which originated in these exaggerated reports, and attribute effects to causes that have no actual connection, the one with the other.

Another cause of misconception of facts can be found in that experience which Marchese shared with many other progressive and learned engineers, that are forced by the exigencies of their task to employ skilled help, and who have only too often the experience that such help are much disposed to ascribe to themselves the greater part of the merit and honor of success, and for the purpose of supporting their claim decry their master's action, and ascribe to some unimportant detail, in which they have been helpful or instrumental, the success of the total project. In no other technical branch has such arrogance been more rampant than in the electrolytical production of metals. A clear understanding of the true conditions, as they are to be complied with, will prove the best remedy against all prejudice and false claims.

I shall therefore describe one after the other the single parts of the necessary apparatus and show the requirements thereof.

The Electrolrtic Bath Vessel or Vat.—For alkaline electrolytes cast iron vessels are preferable to all others, and their form may be governed by both the nature of the material used in making the vessel and by the special technical requirements of the special case in hand.

In copper electrolysis we mainly deal with acidulated electrolytes, and in using such the wooden vessel supersedes all others. And among all kinds of lumber pitch-pine deserves preference, and yet the parts of the vessel previous to their joining as well as the vessel when in shape require a triple coating of asphaltum varnish inside and outside to protect them against the electrolyte as well as the electrolyte against reaction and absorption on the part of the vessel. The planks of which the vessel is made should have a thickness of not less than three inches.

So far only vessels of rectangular sections have been used. But with all the care and ingenuity applied in making their joints, there has been no success in making them secure against leakage occurring at some time or other. Some such construction alone can fully answer the purpose in which the vessel may be made tight without more difficulty than that experienced with a barrel, and which, nevertheless, should be open at the top and rectangular in the section that conforms with the position of the electrodes. Fig. 1 shows part of a wooden vessel that answers these requirements. Not only can the joints be drawn together with the same facility as those of a barrel but its semi-circular bottom and square top part also adapt it closer to the requirements of the case than the vessel of exclusively rectangular sections. Heads, crossbars and hoops as well as grooves in the staves, and eventually some

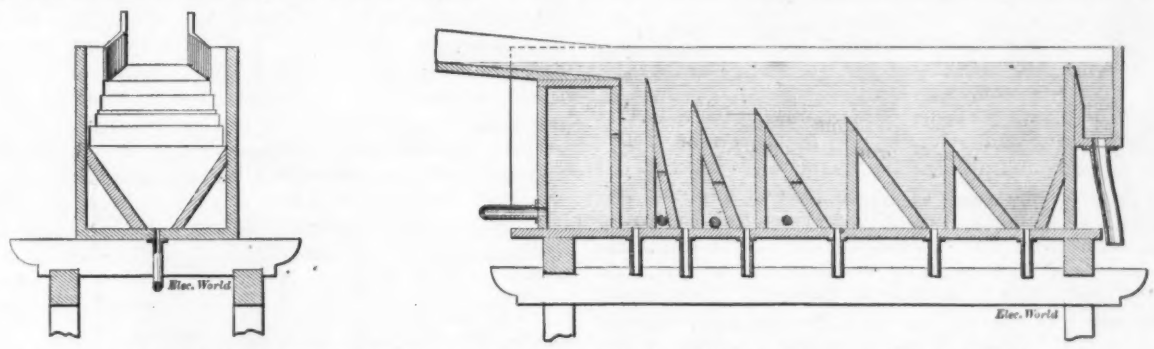


FIG. 2.—APPARATUS FOR CLEARING THE ELECTROLYTE IN CIRCULATION.

wedges between crossbars and head tops draw all joints tied by means of nuts on the hoop-ends that pass through the ends of the crossbars

If Messrs. Siemens & Halske line their rectangular electrolytic vats with asphaltum soaked just in order to prevent leakage, the fact may be assumed as well settled, that rectangular vessels cannot be constructed to be barrel tight in themselves, and there appears nothing more advisable than that the vat with the semi-circular bottom be generally put to use.

The electrodes used with these vessels are of the common rectangular form and hung or supported by wooden transverse bars, or in any other convenient method, by which their non-contact with one another is not interfered with. This leaves the lower semicircular space of the vessel for both the cathion bag, in case operation is directed toward obtaining a loose or crystalline cathion, and for the anode-mud and the zone of turbidness resulting therefrom, and from the movement of the electrolyte itself.

No better opportunity will occur to speak of the requirements in regard to the circulation of electrolyte than the present one.

In each circulation the direction of movement, notwithstanding all reasons that might be quoted in support of a different conclusion, must be in absolute conformity with the natural movement of the subsiding anode-mud. In this way alone can general turbidness of electrolyte be avoided, and unless this be avoided no clean or pure cathion can be expected or obtained. The flow of electrolyte therefore must be from surface to bottom of the electrolytic bath, inflowing and outflowing quantities being equal absolutely, and inflowing quantity being well distributed to reach the electrode face as the special nature of the case will demand.

But little attention is paid in actual practice to the thorough clearing of the circulating electrolyte of all turbidness (solid particles floating therein), before it re-enters the electrolytic vessel, and as a consequence the quality of commercial copper cathion is no longer what it once was and what it should be, and the margin of 1¼ cent. that once ruled between best selected and ectrolytically refined is accorded only in the few cases where the method applied warrants absolute purity of product, and yet it should not be overlooked. that for copper mattes obtained from vicious ores really no other method of refining can produce pure copper than the electrolytic method.

In Fig. 2. an apparatus is shown, which single or set in proper connection with one another will thoroughly clear the electrolyte of its turbidness, when the electrolyte is passed over it in not excessive velocity and quantity. Its construction is based on the fact that solid particles of higher density than the medium surrounding them, that otherwise (in a stable medium) would subside, may be kept in suspense by a movement of the medium, that counteracts their fall. Each particle of solid matter having according to its physical qualities a maximum velocity, with which it can fall in a medium a diminishing counter action of the medium must result in the successive subsiding of solid particles in the order of their falling velocities, until in nearly quiet water even the finest of particles subside. With this arrangement all particles of metallic cathion or metal that may have been pure in the anode and have dropped into the mud are collected in the first and smallest compartment of the apparatus; and true sulphides that have dropped from the anode will collect in the second or third compartment, when the flow is well regulated, while the fine sulphur flour collects in the last compartments or in supplementary clearing apparatus of the same description that are fed from the lower outlets of the first one. The necessity of supplementary clearing apparatus being connected with the first one becomes evident when the electrolyte leaves the first one in a turbid state. It should be entirely transparent when returned to the bath, and the clearing apparatus must be of such capacity as to bring this about in one and the same circulation out of and back into the bath. No turbidness will resist the action of such a well appointed apparatus, the cases being rare where a heating of the electrolyte has to be resorted to, in order to cause the very finest mud to subsequently subside, when conducted over a supplementary clearing apparatus.

In connection with the form of vessel thus shown it will prove of great convenience to suspend all electrodes and cathode bags from covers that fit to the spaces between the top cross pieces, and to provide these covers with eyes or hooks for lifting them out of the vessel by machinery, for the purpose of interchange and cleansing. The vessel being supported at only a few places by the segmental blocks, their total insulation is much more easy than that of square bottomed vessels, and the ground currents are more easily avoided, a quality which is of a higher practical value in preventing waste of power than is usually realized by those practically engaged in the business of electrolytic copper refining.

This particular form (section) of vat applies itself well to the requirements of divided anode and cathode spaces, as they are conditional for such electrolysis schemes where the reaction at the anode prepares the electrolyte for its functions as solvent to be exercised on some material outside of the electrolysis vat itself, and where the electrolyte has to leave the vat and anode space and to circulate outside of it before it may enter the cathode space. Whatever the material (canvas, paper, pasteboard, porous earthenware, etc.), of diaphragms be, a groove in the sides and bottom of the vat keeps them well in place, as long as they are made to resist side pressure.

Anodes.—A great amount of inconvenience has been experienced in connection with the anode plates. All copper mattes* are more or less brittle, and even with great care in handling them many anode plates would break before they were set in position, and when in position uneven decomposition or a slight touch would cause them to break or even crumble. And here it is that the inventiveness of some followers of Marchese stepped in to offer relief.

Carlos Stolp (Nov. 21, 1866), of Santiago, Chili, cast the anode plates around wire cloth to keep their parts together, though they may have parted by cracking, finding it advantageous to connect the electric conductor with the wire cloth rather than the anode material direct. The cost of wire cloth is not irrelavent, but some system such as indicated by Stolp may be employed that does not cause as much cost as when the material used is manufactured wire cloth. I would recommend a number of rods, cast of electrolytic copper, with a projecting hook-shaped bend at one end, by which to suspend the plates cast around these rods. It causes but very little inconvenience with molds properly fitted to cast the matte, at the smelting furnace,

* The word "matte" is here used as a general designation for the products of copper smelting, not being pure copper as yet. The specific names for the different degrees of pureness are used very indiscriminately, but may be stated to refer to approximately the copper contents, as here marked therewith (after Percy, Peters and others):
Blue metal with 50 to 70 per cent. of copper.
White metal with 70 to 89 per cent. of copper.
Pimple copper with 89 to 95 per cent. of copper.
Black " " 95 " 97.5 per cent. of copper.
Blister copper with 97.5 to 98.95 per cent. of copper.
All of which are distinct from ingot with 99 to 100 per cent. of copper, sold as "copper" proper.

around these (heated) rods, and they can be used repeatedly and all that they lose in weight is recovered as cathion. The number of rods in one anode plate depends on the brittleness of the matte in each case. Even when a break in the anode plate occurs in the same direction as the rods run, no inconvenience is experienced therefrom, as long as all of them re i n in electric connection, but the bare rods must not be exposed to contact with the electrolyte.

The inconveniences resulting from the breaking of anode plates in no less measure than other causes have also led to the setting of these plates as well as of the cathodes in a horizontal position, so that they may be supported on frames, rods, stops or wedges in many parts of their downward faces. As far as ascertainable this horizontal position of electrodes after having been suggested by Andre, had been introduced by Siemens & Halske for single sets in connection with their electrolytic copper production scheme, for which they obtained patent in 1886, and they likewise and as a natural sequence of the position of electrodes, introduced the diaphragm intermediate between the cathode above and the anode below.

On Nov. 28, 1888, Edward L. Smith, of Ansonia, Conn., a little town most prominent for its copper industry, had a patent granted to him for the arrangement of electrodes in a horizontal position and in a vertical column, supported by insulated supports, having between them also in horizontal position canvas diaphragms.

But Smith's innovation involves more important modifications of previous practice than what is described in his patent. These modifications consist in the total discarding of special anodes, as well as of special cathodes, by connecting the poles of the dynamo exclusively to the last ones in a series of plates, cast of impure copper, causing one of their faces to act as anodes and the other of their faces to act as cathodes. This arrangement, although adopted with some slight unimportant modifications in part in six of the fourteen North American establishments doing electrolytic copper refining, is productive of impure cathions, unless quite extensive precautionary measures are taken, and will, in consequence, have to make room sooner or later for a more reliable arrangement.

A New Anti-Friction Metal.

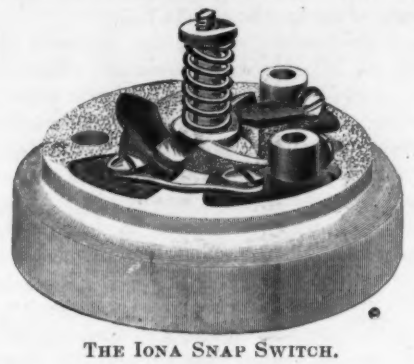
One of the great problems in mechanics is the reduction of friction to a minimum. During the past four or five years a number of anti-friction metals have been placed upon the market, most of which possess more or less merit. A new metal, manufactured by the Electricon Metal Company, 29 Broadway, New York City, has recently made its appearance. "Electricon" is the name of the new anti-friction metal. If time and continued use verify the results that have already been reached it bids fair to be one of the anti-friction metals of the future, as the following experiment goes to show: A cylindrical shaft 1½ inches in diameter, coned at each end over a length of 1⅝ inches and to a diameter of 5-16 of an inch was revolved at the rate of 2,000 revolutions per minute in two plugs of electricon, under a pressure of 2,000 pounds. The results showed a temperature of 185° on a thermometer held against the cone, and no melting resulted. All other metals showed 300° or more and certain of them melted. These gratifying results have induced some of the largest corporations operating machinery to make trials of this new metal. It is now being tested on the Union Pacific, Great Northern, Long Island, Erie, Northern Pacific, Wabash, Louisville & Nashville, Southern Pacific, Baltimore & Ohio, and 40 other railroads; the Baldwin, Pittsburgh and Schenectady Locomotive Works; the White Star line of steamers, Harlem Towboat Company, Westinghouse and Thomson-

The Iona Snap Switch.

Houston electric companies, New Jersey Traction Company, Toledo Electric Railroad, West End Railroad of Boston, and others. The claim is made that the metal is especially useful in electrical apparatus, as its greatest efficiency is shown where high speed is required under heavy pressure. The company makes the additional claims in favor of its metal that it saves 75% of oil; that it will wear twice as long and stand greater pressure than any other friction metal; that it conducts heat from the bearings; that it is very soft while being finely crystallized.

The Iona Snap Switch.

The Iona snap switch, which is something quite new in that line, is shown in the accompanying illustrations. It is a switch and cut-out combined, every switch being fitted with a fuse. This switch is simpler, and has fewer parts than other circuit breakers. There is practically nothing to wear out, it is convenient to wire, and the contacts are of soft brass, which obviates the difficulty experienced with spring clips, which lose their

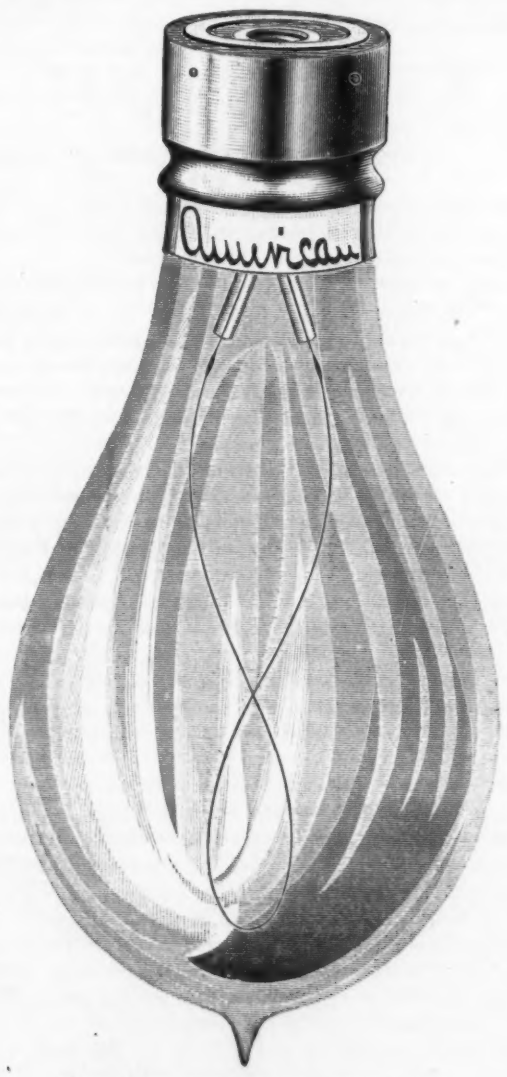


The Iona Snap Switch.

temper by heat and render the switch useless. This switch is made of vitrified porcelain, nickel covers, and also in china, both plain and decorated. It is being put on the market by the Redding Electric Company, 41 Federal street, Boston.

The American Incandescent Lamp.

An incandescent lamp which has met with excellent success is that which is shown in the accompanying illustration, and which has been placed upon the market by the American Electrical Manufacturing Company, 2011-2017 Pine street, St. Louis, Mo. This lamp is neat in appearance, finished in workmanship, and contains only the very best material. Every lamp is carefully tested before leaving the factory, and an average life of 600 hours is guaranteed. It is claimed that thousands of them have burned continuously for over 2,000 hours and are still serviceable and in good condition. As to

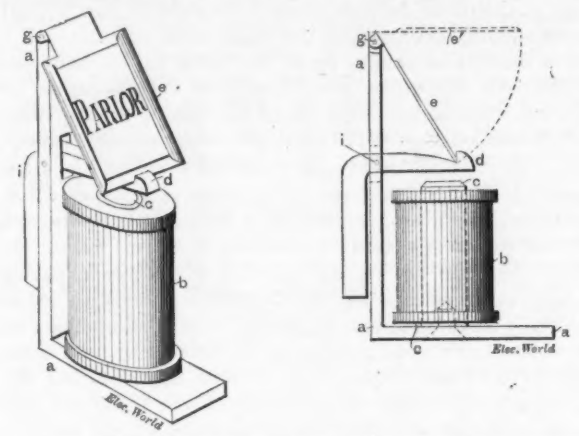


The American Incandescent Lamp.

efficiency, the requirements and ideas of lamp consumers vary according to the service they desire and the power at their command. To meet these various demands the company is prepared to furnish lamps for any rate of efficiency from 3.3 to 4.5 watts per candle, although 3.8-watt lamps are supplied where no preference is stated. The high voltage lamps, 100 volts and upward, are made with an "anchored" filament when so desired, and are recommended for use in horizontal positions or where they are subjected to excessive vibrations. Especial attention is given to the railway lamp; the filament is prepared by a special process particularly adapted to withstand sudden variations of potential, and being anchored is not susceptible to the constant vibrations and strains incident to street car service. These lamps have been thoroughly tested by long use and with very gratifying results.

The Moore Electric Annunciator.

Mr. Erastus D. Moore is the inventor of an improved form of electric annunciator. A glance at the illustrations will suffice to show how this little device works. In Fig. 1 the annunciator is set ready for operation. As soon as the circuit is closed through the magnet by a push button the armature d is attracted and the shutter e falls or is thrown down by a spring. The magnet is supposed to be in a horizontal position so that the shutter is at an angle of 45° and cannot be seen before it falls.

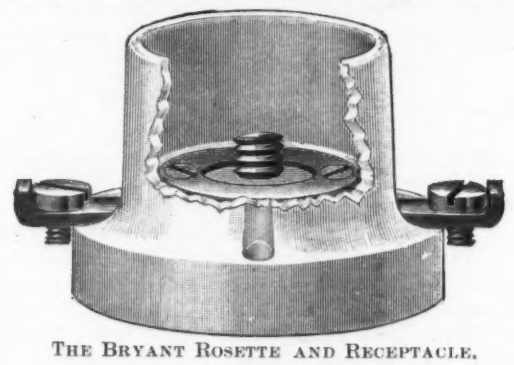


The Moore Electric Annunciator.

The armature, having a counterbalance arm, will return to its natural position, but the shutter is replaced by hand as in most annunciators. The few parts and simple construction of this device render it very reliable.

The Bryant Combination Rosette and Receptacle.

The accompanying cut illustrates a new article recently brought out by the Bryant Electric Company, Bridgeport, Conn. For theatres, temporary wiring and many places where quick work is required, a combination of rosette and receptacle, that does not require the cutting



The Bryant Rosette and Receptacle.

or bending of the main wires, has been found desirable. This article meets the requirements, and being moisture proof, is especially fitted for mill or outdoor work. Both the material and workmanship are excellent.

The Dollar Electric Motor.

The little motor represented in the accompanying illustration, as the name indicates, is intended to be placed within the reach of all. It is designed especially for amateurs and boys in order to give them a proper idea of

The Dollar Electric Motor.

the theory of motors and the practical application of electricity. It contains all the parts of a large machine and will run light mechanical toys. The battery is contained in the base and consists of copper and zinc plates with a chemically prepared pad between them. It is only necessary to add a small amount of water to start the motor. This little machine is manufactured by Robert H. Ingersoll & Bros., 65 Cortlandt street.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, Sept. 17, 1892.

New York General Financial Stock Market.—The announcement at 2:45 o'clock on Wednesday by the Board of Health that the Asiatic cholera had been present in the city since Sept. 6 caused a decline which in the day following reached a basis about equal to that of the decline of two weeks ago when cholera was first reported at Quarantine. The bears used the news as a club and succeeded in not only driving prices down but holding them there. There were spasmodic rallies through Thursday, Friday and to-day, all of which did not stand their ground. Generally speaking the market closed somewhat firmer on news that the Health Department had checked the disease in the city, and the indications are that next week, should there be no greater cause for apprehension, the market will be apt to react. The gold shipments for the week were confined to the $600,000 sent out on Tuesday. Since that day rates of exchange have declined until they have reached a figure which makes it more profitable to import rather than export gold. The most notable feature of the money market has been the disposition of institutions to hold up rates. Banks and trust companies have maintained 5 per cent. as a minimum. Time money continues in good demand, with the supply chiefly for foreign bankers, who insist upon gold notes. The demand for commercial paper, as well as the offerings thereof, are light.

New York Electrical Stock.—The decline in the general market was participated in in a minor degree by the two active stocks on the electrical list. Western Union, of which an extended account will be found elsewhere in these columns, was influenced by other conditions. General Electric, up to the time that cholera developed in the city, gave promise of partially regaining the ground lost the previous few weeks. It started at 111¾; later it sold at 110; on Thursday it was very active on a declining scale under the attack of the bears. The closing to-day was at 111½ to 111⅞, with prospects of an improvement next week. Those who look for an advance in this stock, until there is a general bull market, will reckon without their host. The history of its career during the past two months shows that it follows the movement of the general market very closely. Notwithstanding, as we stated last week, it being a very active stock, it will be very apt to reflect the condition of the market by a more pronounced movement than that which takes place in the general list. Its debenture five per cent. bonds were quite active—$20,000 of them selling at 104 to 103½, the latter being the closing figures.

Edison Electric Illuminating was one of the few stocks which held its own through the week. It received comparatively few sales, the last being on Wednesday at 101 to 102. Its closing was more or less weak, bids being 100 offered and 101 asked. Two small lots of bonds sold at 105¾ to 105⅞.

American District Telegraph received two sales on Tuesday at 60 and 60¼. The closing was 59 bid and 62 asked.

North American was traded in through successive days of the week in a limited way, all its quotations being at 12 and a fraction; it closed at 12⅝ to 12½. Its weakness is probably due to the decline in Northern Pacific common, of which it is a large holder.

Westinghouse.—A contemporary publishes the following: The Westinghouse Electric Company has just finished a 700-h. p. motor for the Brooklyn Railway Company. The cost was about $4,200 and the price received $15,000. The first contract on incandescent lamps for the World's Fair has been nearly completed and it is claimed that a net profit of $104,000 is shown. It is estimated that entire contracts will show net profit of $300,000.

Boston Electric Stocks.—The electric stocks have reflected the prevailing weakness in the market, and fluctuation shows plainly the depression that has been on the entire market during the week. General Electric opened at the beginning of the week strong and at a high figure, but each day since it has recorded a loss. The bears in desperation say that the bottom will soon drop out of it and carry it to lower figures than ever, but the strength of the company itself and the known support behind it will not likely allow any such theories to be realized. The existing scare has successfully shaken out the weak stock and until confidence is restored the buying is very light. The stock closes at about 10½, a loss of about 5 points for the week. At these figures, friends of the company and investors in general consider it a good purchase. Westinghouse has been strong and its loss is almost imperceptible, much less than in the case of other stocks. All reports from the company seem to grow steadily in their favorable character. They report business far in advance of anything previously done. Bell Telephone has sold in small lots at 202 to 204, ex dividend of $3 per share. Prices on Fort Wayne, and the Series A remain unchanged at 12¾ and 8 respectively. No sales of Detroit stock for the week.

The United Electric Securities Company, of Boston, have made their fourteenth call, inviting proposals for the sale to the company of its collateral trust 5 per cent. bonds, as follows: $95,000 of its third series, $15,000 of its fourth series, $100,000 of its sixth series. The proposals are receivable at the office in Boston up to Sept. 19. If these bonds are bought, as it is more than likely they will be, in these amounts, the outstanding bonds then remaining in the respective series will be as follows: First series, due 1920, $118,000; second series, due 1920, $101,000; third series, due 1920, $269,000; fourth series, due 1920, $288,000; fifth series, due 1920; $1,000,000; sixth series, due 1920, $900,000; seventh series, due 1920, $1,000,000. The seventh series was put out by the company Sept. 8, dated Aug. 1, and were sold at 90. Since the first and second series were placed over a year ago, and established a position of good credit for the company, the bonds of all the succeeding series have found a ready market, mostly in Boston and neighboring cities, among corporations and banks. Since these bonds are all debentures and are backed up by lighting and railway companies' first mortgage bonds, it shows the immense quantity of these securities that are existing, arising from the Thomson-Houston Company's business alone, as they do, and the successful career of the United Company proves that electric bonds can now at all times find ready purchasers. There are two large houses in Boston which take $400,000 of every series that is issued. The trust companies there are also willing purchasers. Closely allied to the United Company is the Industrial Improvement Company, a separate corporation managed by the same parties as the former company is. This company is occupied in the business of strengthening street railway corporations and changing their motive power from horse to electric. Up to this time they have accomplished this purpose in Atlanta, Ga.; Brockton, Mass.; Haverhill and Groveland, Mass., and Allentown and Bethlehem, Pa. The company financiers the property, which they take by buying the stock, which gives them control, and then they bond it, and secure whatever capital is necessary for the exchange of motive power and other improvements. Where local interest is lacking in street railway matters this company supplies the most necessary factor of enterprise, resulting in vast improvements to the property itself, and the comfort of the public is effected thereby.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Sept. 17, 1892, and the range for the week in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Low-est.	High-est.	Bid.	Ask'd.
American District Tel....	100	3,825,000	60	60¼	59	62
American Tel. & Cable..	100	14,000,000	....	....	85	87½
Central & So. Am. Tel....	100	6,000,000	....	....		
Commercial Cables.....	100	7,716,000	....	....	156	162
Gold Stock & Tel.....	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	94¼	97⅛	95	95⅛
Real estate bonds.....	1,000	1,219,000	....	....	....	..
Debenture bonds.....	1,000	4,920,000	....	....	....	....
Collateral Trust 5's....	1,000	8,181,000	103⅛	103⅛	....	....
North American.....	100	39,767,200	12½	12⅝	12⅛	12⅛
Brush Ill. Co. of N. Y....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.,....	100	6,500,000	101	102¾	100	101
" " lsts.....	...	.....	105¾	105⅞	...	....
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	4 2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El Light.....	100	1,000,000	....	....		65
General Electric.....	1,000	50,000,000	110	113	110¾	111
Debenture 5's	....	.....	103⅛	104	....	....
Automatic Exhibition Co.	...	2,500,000	...	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	65
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph.....	...	2,000,000	....	....	2	5
North American Phonograph.....	...	2,000,000	....	....	4	6
Westinghouse Elec. & Mfg. Co. 1st p. 7 per cent. Cum.	...	3,717,253	....	....	....	..
E. & M. Co. Assg.....	50	5,038,116	....	....	77	77

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8½	9
Thomson-Houston Elec.—Series D.....	sh	120,000	8¼	8⅛	7¾	8
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	....
Thomson European Elec. Weld.....	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com.....	..	6,000,000	39	37	37	37½
Westinghouse Elec.—Pfd.	..	4,000,000	51	49¾	49½	50
General Electric.....	..	30,067,200	115	110¾	110¾	111
" " Pfd ...	...	4,136,300	120	119		119
Fort Wayne Elec.....	25	4,000,000	12¾	12½	12⅝	12¾
Fort Wayne Elec.—Ser. A.	sh	80,000	8¼	8	8	8⅛
Detroit Elec.....	10	750,000	6¾	6¾	6¾	7
West End St. Ry. Co.—Com	50	7,150,000	73	71½	71⅛	72
West End St. Ry. Co.—Pfd	50	6,400,000	87½	87¼	87¼	87¼
American Bell Tel	100	15,000,000	204	202	203	203½
Erie Tel. & Tel. Co.....	..	4,800,000	45	....	45	46
Mexican Tel. Co.....	10	1,280,000	....	....	1.00	1.10
New Eng. Tel. & Tel. Co..	..	10,304,600	57½	....	56	....
Tropical Tel. Co.....	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago.....	....	220	Chicago Arc Light & Power Co.....	98	102
Central Union.....	57	60	Chicago Edison Co. ex-rights.....	145¼	..
Iowa Union.....	20	25			
Michigan	90	95			
Missouri & Kansas..	56	60			

Western Union.—The news that this company would not increase its regular quarterly dividend, but that in all probability it would issue a stock or scrip dividend, reached the street on Wednesday. Many thought that the result would be a radical advance in values. Older heads, however, knew better, as they consider that the advance the past six weeks has been in anticipation of such an event, and consequently had discounted it. After the announcement of the action of the Board of Directors the tendency, if any, was slightly downward, probably due to general market conditions mentioned preceding. The decline in the stock has had a tendency to increase the bullish feeling, as it has opened up without bringing out stock, and whenever it has been sold down good buying orders have been met. It is believed that an operator who sold freely at 96 has been recovering below 95. Another version is that an attempt by a recent seller to get the price down has been resisted by members of the Gould party. Mr. George Gould is said to have told a friend to buy Western Union at par when the stock was selling between 95 and 96, assuring him that there would be very little decline. There was a rumor yesterday, and one that was hinted at in these columns a month ago, that the new capital stock, or a portion thereof, might be used in a Postal Telegraph deal, and the recent rise in Postal Telegraph was cited as evidence in support of this theory. Directors have given no encouragement to this view, but have said to acquaintances that they supposed the plan of giving stockholders 10 per cent. in scrip and keeping the balance in the treasury, at least temporarily, might be carried out. The directors of this company met on Wednesday, submitted the annual report, declared the customary quarterly dividend of 1¼ per cent., and decided to increase the capital stock to $100,000,000. The capital stock is now $86,200,000; this proposed increase of $23,800,000 represents money paid out for extensions and betterments. We understand the policy will be to give stockholders 10 per cent. on their present holdings in the form of a stock dividend. In this way $8,620,000 would be distributed, leaving $5,180,000 treasury stock. The idea is to keep up the present rate of dividend upon the total capital of $100,000,000. In order to conform with the law a special meeting of stockholders has been called for Oct. 25 to take action on this proposed increase. This is only a mere matter of form, as the directors voting the same represent a large majority of the stock. It will require five weeks' time to advertise the proposed stock issue before any distribution can be made. Consequently, the supposition is that the "melon will be cut" at the next dividend meeting, three months hence. The financial report for the quarter ending Sept 30, partially estimated, as compared with the corresponding quarters in previous years is as follows:

	1892.	1891.	1890.	1889.
Net revenue.....	$2,200,000	$2,000,000	$2,000,000	$1,750,000
Interest and surplus fund.....	242,960	242,388	243,200	210,000
Balance.....	$1,957,040	$1,757,612	$1,756,800	$1,540,000
Dividend.....	1,077,410	1,077,405	1,077,400	1,077,385
Surplus.....	$879,630	$680,207	$679,953	$462,615
Total surplus.....	14,455,757	12,097,918	10,642,383	9,647,016
Price of stock	95	85½-81⅛	84¼-83½	87-84⅛

From data relative to the quarter ending June 30, just obtained, we are able to anticipate the report for the fiscal year ending June 30, which will be issued at the next meeting:

	1892.	1891.	1890.
Net revenue	$7,298,545	$3,605,583	$7,313,725
Interest and sinking fund.....	970,523	931,218	915,135
Balance.....	$6,428,022	$5,674,365	$6,397,590
Dividends.....	4,309,637	4,309,606	4,956,008
Surplus.....	$2,118,385	$1,364,759	$1,441,58

The record for a series of years makes the following showing:

	Net.	Surplus after payment of dividend.
1889.....	$5,422 373	$1,112,853
1888.....	5,070,570	456,: 63
1887.....	4,037,281	2,692,3o2
1886.....	3,919,855	14,170
1885.....	5,707,924	166,535
884.....	6,610,4 5	498,915

The Copper Market.—The bottom has dropped out of the copper market, so far as prices are concerned. Last week actual transactions took place in a limited way around 11⅛ cents for lake. This week the minimum price has been 11 cents, and the maximum, so far as can be learned, 11¼. Considerable tonnage exchanged hands. Much of this was in second lots, and was evidently put out for the purpose of bearing the market. Be that as it may, the producing companies have been known to sell at current quotations. Consumption is very light and manufacturers claim that they can allow the market to continue in its present downward course awhile longer. When we consider that consumption is at the minimum, that exports are below the normal, and that production continues in about the same ratio, it is logical to conclude that stocks are accumulating rapidly. No one knows just what the Calumet & Hecla is doing, but the supposition is that it has not been in the market lately. We would not be surprised to hear of its making an open sale at 11 cents, in which case it will probably set the pace of the market at that figure. Exports of fine copper for last week from this port were 508,568 pounds, and matte 322,840 pounds.

Wall Street Notes.—A representative of THE ELECTRICAL WORLD called President Thompson's attention to the item floating through the press which was to the effect that the National Lead Company was negotiating for a process by which to electrolytically manufacture white lead. He said: "If we are, I did not know of it. There is no process yet invented that will equal the good old fashioned corroding system now in use."

Bell Telephone has declared a regular dividend of $3 per share, payable Oct. 15 to stockholders of record Sept. 20.

The New York & New Jersey Telephone Company has disinfected its telephone lines in Elizabeth, N. J., by applying a bichloride of mercury and salt to the transmitters.

Mr. Geo. Westinghouse, Jr., and a number of capitalists interested in his electric enterprises, have just returned from an extended trip of investigation. They found the company's works all over the country doing an enormous business, on a cash basis, and one which is monthly increasing. It is expected to handle $10,000,000 worth of business in the next six months. A person who is in a position to speak authoritatively says that there is no desire or intention to consolidate with General Electric; that capitalists friendly to the management stand ready to buy the entire treasury stock at a number of points in advance of present quotations.

NEW INCORPORATIONS.

The Peoples Electric Company, of Braddock, Pa., capital stock $3,500, has been incorporated to supply light, heat and power to the public. A. T. Reid, J. K. Mills and E. J. Small are those interested.

The Capital City Electric Light Company, of Madison, Wis., capital stock $40,000, has been formed to establish and maintain an electric light and power plant. H. Schulkamp, C. J. Hamman and J. Schulkamp, are the incorporators.

The Electric Manufacturing Company, of Oconto, Wis. capital stock $50,000, has been formed to manufacture and sell incandescent electric lamps. George Beyer, T. A. Pamperin and J. B. Grunert, are the organizers.

The Maroa Electric Light Company, of Maroa, Ill., capital stock $12,000, has been incorporated to erect and maintain an electric light, heat and power plant, in that town. J. Crocker, George Conover and Will Schenck are the promoters

The Ridge Avenue Connecting Railway Company, of Philadelphia, Pa., capital stock $6,000, has been formed to construct and operate a street railway in Philadelphia. The organizers are David H. Lane, Richard F. Bower and John B. Peddle.

The Dunlap Electric Company, of Brownsville, Pa., capital stock $5,000, has been formed to supply light, heat and power to the public in Brownsville, Pa. George W. Lenhart, S. S. Graham and Chas. L. Snowden are the parties interested.

The Perry Electric Light and Power Company, of Perry, Ia., capital stock $20,000, has been formed to operate an electric light and power plant. The promoters are E. A. Richards, Manson, Ia.; Henry C. Hock, and John Hock, of Perry, Ia.

The Philadelphia & Ardmore Passenger Railway Company, of Philadelphia, Pa., capital stock $40,000, has been formed to conduct and operate an electric railway. Fred. P. Hays, Frank French and James Smith are the promoters.

The New Gaynor Electric Company, of Louisville, Ky., capital stock $100,000, has been formed to manufacture electrical appliances and patent rights, etc. Henry F. Donigal, J. W. Dawson and John Fowler, of Louisville, Ky., are the organizers.

The Allegan Electric Light and Power Company, of Allegan, Mich., capital stock $40,000, has been formed to generate electricity for light and power. T. B. Harrison, Geo. W. Tyler and M. D. Buskirk, of Paw Paw, Mich., are the parties interested.

The Iron River Water, Light and Power Company, of Iron River, Wis., capital stock $50,000, has been formed to construct water-works, electric light and power plants at that place. Mark Hessey, S. F. Staples and F. O. Ditmar are the organizers.

The Fox Chase Electric Light, Heat and Power Company, of Philadelphia, Pa., capital stock $25,000, has been formed to supply light, heat and power by electricity to the public. Jos. W. Crawford, R. T. Martin and H. B. Rowland are the promoters.

The Lackawanna & Old Forge Street Railway Company, of Lackawanna, Pa., capital stock $36,000, has been formed to construct and operate an electric railway in Lackawanna county. John Graham, W. G. Eno and G. R. Bedford are the incorporators.

The Declez Granite Company, of Los Angeles, Cal., capital stock $250,000, has been formed to deal in electric power, railroads, tramways, etc. The organizers are Wm. Declez, Earl A. Rogers, A. P Halfhill, J. H. Johnson, and Henry Lapham, of Los Angeles, Cal.

The Columbia Manufacturing and Supply Company, of Chicago, Ill., capital stock $10,000, has been formed to manufacture and sell electrical instruments, etc. Dr. F. K. Coykendall, Claude R. Baum, Thomas Hull and John T. Todd are the incorporators.

The Bellefield Street Railway Company, of Pittsburgh, Pa., capital stock $12,000, has been formed to construct and operate a street railway in Pittsburgh, Pa. Geo. W. Elkins, Wm. L. Elkins, of Pittsburgh, and Joseph Stuart, of Allegheny City, are the incorporators.

The Socorro Electric Light Company, of Socorro, N. M., has been incorporated with a capital stock of $25,000, for the purpose of generating electricity. Michael S. Hart, Adin H. Ebitmore, Paul A. Marceline, Antonio Cortersey and Trinidad Romero are the organizers.

The Aspinwall Street Railway Company, of Pittsburgh, Pa., capital stock $12,000, has been organized for the purpose of constructing and operating an electric railway in Ohar township. John B. Jackson, John G. Holmes and James J. Donnell are the incorporators.

The Economy Safety Heating Company, of Cleveland, O., capital stock $50,000, has been formed to manufacture and supply steam and electric power for buildings. W. W. Williams, Cecil L. Saunders, George D. Breck, Chas. Warren and Melville L. Warner are the promoters.

The New York Superheating and Purifying Company, of Jersey City, N. J., has been formed with a capital stock of $25,000, to manufacture all kinds of steam and electric lighting appliances. S. W. Parket, Mamaroneck, N. Y.; H. Puster and C. W. Wenner, both of Jersey City, are the organizers.

The Water and Electric Light Company, of Miles City, Mont., capital stock $50,000, has been formed to furnish water and electric light to residents of Miles City. W. R. Gilman, Chicago, Ill.; Berthold Ullmann, W. T. Schmalsle, H. F. Batchelor and Wm. Courtenay, all of Miles City, are the incorporators.

The Bradbury-Stone Storage Battery Company (Western), of East St. Louis, Ill., capital stock $500,000, has been started to manufacture and sell electrodes for storage batteries, electric light and heat plants, motors, electrical goods, etc. The organizers are S. M. Stevenson, Thomas B. Crew and Frank P. Hager.

The Marshalltown Light, Power and Railway Company, of Marshalltown, Ia., capital stock $250,000, has been formed to construct and operate a plant for furnishing electric light, power and street railway operation. C. D. Jones, S. B. Hovey, M. W. Hovey and G. S. Woodruff, of Marshalltown, are the promoters.

The United Electric Company, of Dennison, O., capital stock $100,000, has been formed to build and operate an electric street railway. Thomas H. Wilson, George T. Fleming, Wm. H. Smith, Clement V. McCluskey, Thomas Wright, William D. Collier, Edward E. Elom and Charles A. Johnson are the incorporators.

The Virginia Light and Water Company, of Duluth, Minn., capital stock $20,000, has been formed to manufacture electricity for light, heat and power, and to establish and maintain water-works in towns and cities. O. D. Kinney, Ely, Minn.; A. E. Humphreys, and Geo. W. Buck, of Duluth, Minn., are the promoters.

The Pottsville, Cressona, Schuylkill Haven and Orwigsburg Electric Railway Company, of Pottsville, Pa., capital stock $75,000, has been formed to construct and operate an electric railway in Schuylkill county. L. K. Hannum and Charles W. Wildermuth, Pottsville, Pa., and Geo. F. Dengler, Schuylkill, Pa., are the incorporators.

Special Correspondence.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Sept. 17, 1892.

Mr. George Cutter, of Chicago, is visiting the Hub this week

The Electrical Supply Company, of Ansonia, Conn., has increased its capital to $250,000.

Stephen E. Barton, secretary of the General American Department of the Lancaster Insurance Company, of New York, paid a visit to this office on his way to the coast.

Messrs. Gillis and Gleason, of Boston, are the successors of A. L. Russell. Mr. Duncan Gillis has been in business for thirteen years, while Mr. Thomas W. Gleason has been an employé for some time in the late establishment of A. L. Russell.

The Eastern Electrical Supply Company, Franklin street, Boston, dealers in electrical and street railway supplies, has made an assignment to Ira C. Herzey for the benefit of its creditors. It is understood that the indebtedness will be met in full.

Mr. C. F. West, of Concord, N. H., called at this office recently, representing the Stevens process of splicing arc light carbons, which is destined to save waste pieces of carbon. It is in practical use in a number of plants in New England and is proving to be a success.

Crowell & Co., Boston, Mass., are introducing the Hammond porcelain cleat, a radically new departure, which is being received more than favorably by the trade, as indicated by large orders already received. Mr. Hammond, the inventor, is brother of the inventor of the Hammond typewriter.

Dedham, Mass.—Plans for a 700-light incandescent electric plant which will be immediately installed have just been completed by the Massachusetts Electrical Engineering Company, of Boston, for the Merchants' Woolen Company. The contract was awarded to the Westinghouse Electric and Manufacturing Company.

Rumford Falls, Me., is to have a model electric lighting plant. Both arc and incandescent lights will be supplied from a central station situated by the Upper Falls and running from the water power there obtainable. The station will have a capacity of about 200 h. p., only a part of which will be used at present. The work is in the hands of the Massachusetts Electrical Engineering Company of Boston.

Extensive changes are being made in the power station of the Watertown electric lighting works, due to the fact that the present plant is now overtaxed. A new 30 × 50 engine house is being built, and when it is completed a 700 h. p. Wheelock engine will be placed in position. A shaft is to be placed the entire length of the power house, and all the dynamos are to be run from that single shaft. This improvement means a change from a high to a slow speed station. The company has recently put in a dynamo of 2,000 commercial light capacity, and as soon as the new engine is ready for use this machine will be started. At present this company is furnishing power for 105 arc, 783 street and 2,600 commercial incandescent lights. Applications for over 600 additional incandescent lights have been received. The improvements and alterations will cost about $25,000.

Hearings have been given at Stoneham, Mass., on the petitions of the Boston, Malden & Stoneham and the Stoneham & Boston Electric Street Railways, for location of tracks, the former for a location between Central Square, Stoneham and Malden, and the latter between Reading and Malden, including the same route as asked for by the former. The New Wakefield & Stoneham Street Railway, which has just completed its line between Wakefield and Stoneham, has also petitioned for a location between Stoneham and Reading, over the same route asked for by the Stoneham & Boston Railway. Electric street railway matters in Stoneham are thus rather complicated at present. The Wakefield & Stoneham Railway Company has also asked the Woburn Board of Aldermen for a location between Reading and Woburn. It has already been granted locations between Wakefield and Melrose and Wakefield and Saugus. When these roads are completed this section of country will have a complete network of electric railways. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Sept. 17, 1892.

Mr. Edward Lasell, Kansas City, Mo., has calle on the electrical trade in Chicago this week.

Mr. Jean A. Wetmore, the well-known representative of the Okonite Company, is a World's Fair visitor this week.

Mr. A. D. Adams, general sales agent of the Jenney Electric Motor Company, was a World's Fair visitor this week.

The Illinois Electric Lamp Company is supplying the Western Electric Company with 220-volt incandescent lamps.

Mr. Frank P. Gravely, contracting engineer, of No. 61 Carondelet street, New Orleans, was a World's Fair visitor this week.

Mr. George Cutter leaves for the East this week to complete arrangements for the handling of his fireproof rheostats in that section.

Mr. George Cutter, 333 "The Rookery," Chicago, has sent out an attractive circular calling attention to the improved Schaefer lamp, which he is now handling.

Mr. C. E. Lee, manager of the Western office of the Electric Gas Lighting Company, of Boston, has returned to Chicago from a successful business trip in the Northwest.

The Postal Telegraph Company's main office in the Phœnix Building, Chicago, Ill., was recently temporarily disabled by a fire, the origin of which is not yet known.

Mr. W. F. Richardson, manager of the Enterprise Electric Company, left for St. Louis this week to look after the business of the company at that place, through the new branch house recently established there, at No. 15 North Ninth street.

The Enterprise Electric Company reports that the fall rush is fairly on in all its lines of trade. The N. I. R. Wire is popularizing itself daily because of its seamless qualities and because it is manufactured of the purest and best of material.

The Jenney Electric Motor Company, of Indianapolis, Ind., has secured the order for installing an 800-light Jenney incandescent plant in the Commercial Club's new house in Indianapolis. Habirshaw wire and a system of interior conduiting will be used.

Mr. C. W. Miller, secretary of the Jeffrey Manufacturing Company, of Columbus, O., was a World's Fair visitor this week, where in company with Manager Gregg, of the Chicago office, he called on Chief Skiff, of the Mining Department, and arranged for a large and attractive exhibit of electric and other mine appara tus.

Mr. Clarence Allen Ross and Miss Rhoda Trix Ninde will be married on Thursday afternoon, Sept. 29, at the residence of the bride's parents, 114 South Seventh street, Oskaloosa, Ia. Mr. Ross is the well known manager of the Kansas City office of the General Electric Company and has a host of friends who will rejoice in his good fortune.

The Chicago Electrical Association will meet in its rooms, 48 Athenæum building, 26 Van Buren street, Chicago, on Tuesday evening, Sept. 27, when Mr. C. A. Brown, of the well known firm of Barton & Brown, will read a paper on "What Constitutes Invention." This will be the first of the regular meetings following the summer vacation.

The Columbus, a new State street dry goods house, was formally opened this week, when the decorative electric effects were highly admired. One hundred and fifty arc lights and 1,200 incandescents of the Western Electric type were in circuit, the incandescent lamps for which were furnished by the Illinois Electric Lamp Company, of Chicago.

Taylor, Goodhue & Ames is the firm name of a new electrical supply house established in Chicago on Sept. 15, with headquarters at 827 Monadnock block. Electrical specialties and the general material required in lighting and power installations will be carried in stock. The members of the firm are William Taylor, Wells Goodhue and H. D. Ames.

Mr. W. C. McKinlock, president and treasurer of the Enterprise Electric Company, has just returned from New York and pleasure resorts of the East. He also spent a short time in Bristol, R. I., on a business tour to the National India Rubber Company's factory, for which concern the Enterprise Electric Company has recently been appointed general Western agent.

Commodore Ernest P. Warner, of the Western Electric Company, Chicago, captured the handsome silver cup in the yacht race off Lincoln Park, Saturday afternoon. As it was a race through all kinds of weather, the wind blowing in gusts during the first half of the course, and falling to a summer evening zephyr during the latter part, Commodore Warner received the cup with a feeling that it was well won.

Mr. Dilworth Richardson, general manager of the Carpenter Electric Heating Manufacturing Company, St. Paul, Minn., was in Chicago this week arranging with the Electric Supply Company to handle its heating and cooking utensils, for which there is a steadily growing demand. Mr. Richardson has increased the factory capacity to such an extent that all orders can be quickly handled in a satisfactory manner.

The New Edison Building.—Plans for the new Edison building at Harrison and Charles streets, the site for which was recently purchased for $190,000, have been drawn. The building will be only 60 feet high and will front 210 feet on Harrison street and about 200 feet on the river. The interior will be cut into one large boiler room and two dynamo rooms, the whole being equipped to furnish 50,000 h. p. Extensive docks will be built along the landing so that the company may make ready use of the river.

The Electric Appliance Company is exhibiting a sample of the Schuttler ratchet track drill in its store at 242 Madison street, Chicago. The rapidity and ease with which it puts a hole through a section of rail is surprising. The Electric Appliance Company has in preparation a modified form of the drill which will be known as the "shop drill." This is designed for general shop work, as well as a track drill, and will be a very desirable tool around every electric light station and street railway plant.

A New Incandescent Lamp.—The Illinois Electric Lamp Company, 171 South Canal street, Chicago, has placed on the market an incandescent lamp of simple construction which named the Illinois Waterproof Lamp, and which is intended for use in packing houses, breweries, distilleries, and wherever the lamp is exposed to the injurious effects from condensation of moisture or fumes from smoke or acids. The socket for this lamp costs but a few cents, and the lamp itself is sold at as low a price as any high grade lamp.

Minneapolis, Minn.—Articles of incorporation have been drawn up for a new commercial telephone and electric company, with a capital stock of $1,000,000. The company contemplates a general telephone and telegraph business and the handling of all kinds of electrical supplies. Edward S. Corser, the president of the Minneapolis Brush Electric Light Company; Thomas Lowry, president Minneapolis Electric Street Railway Company; Charles M. Loring, president, and Henry A. Tuttle, general manager of the North American Telephone Company, are interested in the new enterprise.

Mr. Wells Goodhue, who for four years has been connected with the Electrical Supply Company, of Chicago, first in charge of the house goods and later in charge of the electric light department, will shortly sever his connection with that house and join fortunes with Mr. William Taylor, who has started a new supply house in Chicago. Mr. Goodhue was formerly with the Hopkins-Dickinson Manufacturing Company, and is probably known to every buyer of house goods and electric light material in the country. With this wide acquaintance and his genial, persevering disposition, success is only a matter of time.

The Street Railway Convention.—The delegates attending the Street Railway Convention at Cleveland, Ohio, will find that the Cleveland, Cincinnati, Chicago and St. Louis Railway Company, more popularly known as the Big Four route, will take better care of its patrons and furnish better service than any other line running into Cleveland, and it is understood that the majority of the delegates from the Southwest will take advantage of the limited vestibule trains with dining-car service that is afforded by this line. Mr. D. B. Martin, general passenger and ticket agent, of Cincinnati will gladly furnish information regarding the trip to any one desiring same.

Mr. William Taylor, who for seven years has been the assistant manager of the Electrical Supply Company, Chicago, and whose intelligent and persistent efforts have largely contributed to its success, has severed his connection with that company, and established a new supply house with headquarters at 528 Monadnock Building, and proposes to carry a line of important electrical specialties, the exclusive selling agency for which he has secured, as well as general material for electric lighting, railway and power plants. Associated with Mr. Taylor are capitalists of Chicago, who will see that the new enterprise has all the capital that the growth of the bussiness demands, and as Mr. Taylor has been connected with the supply business almost since its inception, and is thoroughly familiar with the needs of central station and isolated plants, there is little doubt but that success will crown his efforts from the start. F. D EL.

TACOMA, Wash., Sept. 12, 1892.

Thomas Holman, of Salem, Ore., has sold his electric light system to a Portland syndicate for about $35,000.

The Union Trunk Line, of Seattle, has installed a 210-h. p. Thomson-Houston generator in its James street station.

Mr. Geo. P. Low, electrical inspector for the Pacific Coast Insurance Union, recently made a tour of the Puget Sound region.

The Northwest General Electric Company recently installed an Edison 200-light incandescent plant in the Kirkland Woolen Mill, in Seattle.

The Union Trunk Line Company, of Seattle, has just put into operation a new 200-kilowatt Thomson Houston w. p. railway generator, installed by the Northwest General Electric Company.

The Northwest General Electric Company, through its Puget Sound headquarters in Seattle, has just completed the rewiring of the steamer Flyer for 150 incandescent lamps and a projector.

The Olympia Light and Power Company has just received an additional electric car, making the fifth in use on its new line. The company carried 2,658 passengers on its cars in one day recently.

The Salem, Ore., electric light and power plant, which is now owned by Portland capitalists, is being greatly improved. Wires have also been strung for power circuits to supply motors which will be introduced.

The Rainier Power and Railway Company, of Seattle, is now operating its Ravenna Park extension, which was recently completed. Its Third street line is about complete and will be put in operation within ten days.

Mr. J. B. Hawley, president of the Union Railway Electric Company, of Everett, Wash., recently left for New York. He will remain in the East several weeks, and expects to place the company's bonds before his return.

The Portland General Electric Company will probably expend $400,000 in the near future in extensions of the water power station at Oregon City, Ore., which it recently acquired from the Willamette Falls Electric Company.

The Fairhaven & New Whatcom Electric Railway Company on Bellingham Bay, which has acquired the interests of the older or "Stringer" line, has re-located a part of the line so as to follow the bay shore instead of running over the hill, as formerly.

The Point Defiance, Tacoma & Edison Railway Company has bought from the N. W. General Electric Company one freight car equipped with two 25-h. p. motors. The company is considering the establishing of a telephone line for car dispatching, etc.

Chas. S. Bowie, manager of the Northwest Electric Supply Company, has closed a contract to wire the Pierce county court house, in Tacoma, and supply the steam and electric plant, consisting of engine and two 450-light Edison dynamos to supply 900 lights. The contract price is $6,150.

The Washington Electric Company, of Seattle, which sold out its interests to Fred E. Sander, has passed into history, and is not to be revived. The new owner has since transferred the plant, lines, franchise, etc., to the Union Electric Company, which is now operating the former company's circuits.

Salem, Ore.—A syndicate, composed of Salem and Portland capitalists, has purchased the Holman light plant and will increase it with a 2,000-light alternating current dynamo, a 50-light arc and an 80 h. p. 500 volt generator. The company is called the Salem Light and Power Company, and has a capital of $150,000.

Seattle's Street Railways.—There are said to be 85 miles of street railway in operation in Seattle, 63 of electric, and 22 of cable, and 10 miles more in course of construction. In street railway mileage this city stands twenty-second in the country, and all cities standing higher have over 100,000 inhabitants, Detroit standing next above.

Oregon Telephone System.—A telephone line has been constructed from Albany, Ore., to Salem, via Independence. It is a continuation of the line recently completed from Portland to Corvallis, thence to Albany. Two wires will next be strung from Salem to Portland, thus completing a circuit of the principal Willamette Valley towns.

The Salem Motor Railway Company, of Salem, Ore., has acquired the property of the old horse-car line, which will be changed to an electric line throughout. An extension is being built to Highland Park. A right of way has been granted through the State Fair Grounds, and the electric line will be extended through to the main entrance.

The Portland General Electric Company at the recent stockholders' meeting elected the following officers: President, P. F. Morey; first vice-president, W. S. Ladd; second vice-president, H. M. Byllesby, St. Paul; secretary, C. H Caufield; assistant sec-

retary, H. C. Levis, St. Paul. Executive Committee, P. F. Morey, C. A. Coffin, Boston, Mass.; H. M. Byllesby.

Mr. J. M. Colman & Sons, of Seattle, recently had a 15-light Edison incandescent dynamo installed in their steam launch Cyrene, by the Northwest General Electric Company. The motive power is supplied by an upright compound engine manufactured by the Messrs. Colman, and the whole installation occupies a space only 20 inches high beneath the deck.

The Tacoma Light and Water Company has offered its extensive light and water systems to the city of Tacoma at the following terms: $2,100,000 taking in payment bonds drawing 5 per cent. interest, or $2,000,000, taking bonds at 6 per cent. Civil Engineer Rudolph Hering, of New York, has been engaged by the City Council to examine and report upon the value of the plant.

The Sunset Telegraph and Telephone Company has about completed its telephone line from Tacoma to Portland, Ore. It is now being operated to Woodland, 115 miles from Tacoma. It is also in operation from Portland to Vancouver. A short line has just been constructed from Bucoda to Tenino to handle through business directly. The amount of revenue derived from the State lines is very satisfactory.

The Tacoma Railway and Motor Company has a new 99-h. p. engine in position, and is improving its service rapidly in anticipation of Exposition travel. Car building is being carried on successfully. Thomson-Houston w. p. equipments being used. Supt. L. H. Griffith has placed an ingenious system of illuminated sign boards on all the cars. Wages of conductors and motormen have been increased to 24 cents an hour on all lines. G. R. DE V.

CANADIAN NOTES.

OTTAWA, Sept. 17, 1892.

Winnipeg.—A test of the east track of the electric street railway service, from the Canadian Pacific track to Broadway, was made this week, when a number of officers of the company made a trip over the line. Everything went satisfactorily.

Victoria, B. C.—The largest wooden steamer ever built in British Columbia is being wired by the Edison company, which will also supply the plant and fixtures. The engine will be of the Ball type and rawhide rope will be used for transmission.

Peterborough, Ont.—The first electric motor used in Peterborough was turned on last week. The Light and Power Company has completed the work of putting in the power generator and is stringing the wires. The first motor was started in the *Times* printing office.

The Dominion Government has given orders for an electric light beacon to be placed on a dangerous rock just outside of the harbor at Victoria, B. C. The government had frequently been asked to place a light here but only consented after the loss of a steamer valued at $200,000.

The Edison Electric Company, of Vancouver, B. C., although it has only been in the new Edison block about one year, is now building a very much larger block, which is promised to be the finest on the Canadian Pacific coast. It will be lighted and partially heated by electricity.

Liverpool, N. S.—E. T. Freeman, agent of the Edison Light Company, has closed a contract with a company in Liverpool for a $10,000 electric plant. Joseph Ennis is president of the company and Emil Hall secretary. The company will supply light for the town and also light private houses, etc.

Ottawa, Ont.—One of the latest applications for heat produced by electricity is the drying of lumber for planing purposes. J. A Parr, of the Chaudière, is having electric drying kilns, the invention of T. Ahern, placed on his premises. The production of heat is becoming in Ottawa one of the most important functions of electricity.

The most complicated piece of work ever constructed in Canada is that now being laid at the corner of King and York streets, Toronto. It was made by the Dominion Switch Company, of Montreal, and consists of 900 pieces of iron, costing about $5,000. Two double tracks cross at right angles, and there are three double track switches.

Vancouver, B. C.—A charter has been granted to a company to take 20,000 h. p. from the River Capilano directly opposite Vancouver. The intention is to build a water power station at this point and transmit the power to a sub-station in Vancouver, about nine miles distant, where motors will drive dynamos, which in turn will furnish current for distribution throughout the city.

Nanaimo, B. C.—At the regular meeting of the City Council last week Alderman Quennell gave notice that he would bring in a by-law to purchase the electric light works, providing the assignee, J. H. Simpson, can show that the works are really doing as well as they are supposed to be. The present plant could not be duplicated for less than $45,000, the price asked for it by the assignee.

St. Catharines, Ont.—Patterson & Corbin, street car builders of this city, have found it necessary to enlarge their works, owing to the large number of orders pouring in. Among the contracts which this firm has on hand are four open electric cars for the Niagara Falls, five for West Toronto Junction, and six for Brantford. In this connection it may be said that the value of cars imported from the United States into Canada during 12 months ending June 30 last decreased from $205,000 to $88,000 as compared with the corresponding period of 1891.

Ottawa, Ont.—R. W. Mason, president of the Railway Equipment Company, of Chicago, was in the city this week and signed papers with Ahearn & Soper by which he secured the right to manufacture and sell on royalty the Ahearn electric car heater and other electric appliances. The rights obtained cover all the world, except Canada. Mr. Mason, speaking of the deal, said: "I have got hold of a good thing. For several months I have been testing and working on Mr. Ahearn's patents, and I have come to the conclusion he has solved the electric heating problem."

Guelph, Ont.—The City Council have adopted a by-law which provides that in consideration of the City Council granting the Bell Telephone an exclusive privilege for five years to carry on a telephone business in this city, and to erect poles of a greater height than 40 feet above the street in place of their present smaller poles, the company covenants to build and maintain connecting telephone lines between Aberfoyle, Morriston and Schaw, Arkell, Eden Mills, Rockwood, Everton and the city; that the city fire alarm wires can be put free on their poles, that the present rate for telephones shall not be increased unless an electric railway necessitates metallic circuits, when the rates may be increased to $25 per house and $35 for business places; that the company assumes all responsibility for any damages which the use of this privilege may entail on citizens, and that the city be not liable for damages done to the company by the introduction of an electric railway, etc.

Brantford, Ont.—Mr. Campbell, of the Edison company, has arrived in the city and commenced an active canvass for private lighting among the stores and dwellings. The promoters of the Brantford Electric and Power Company have issued a notice of their determination to apply for incorporation under the Ontario Joint Stock Companies Letters Patent Act. The directors who make the application are William Buck, Henry Leeming, Alfred Watts, George H. Wilkes and Dr. Digby. The notice sets forth that the objects of the company are to acquire the water power privileges formerly belonging to the Grand River Navigation Company and known as the Brantford Canal Level. The amount of the capital stock of the company is to be $150,000 and is to be divided into 1,500 shares of $1,000 per share. The gentleman already named will form the first directorate of the company. The application for incorporation will be made within a month.

Trenton, Ont.—The Brush Electric Light Company has presented a proposition to the Council for the contract of lighting the town for 10 years. It proposes to give 24 lights all night for $1,440, and to pay as a minimum $240 for 60 h. p. at the dam. This is practically a reduction of 40 per cent. on the whole night electric light service for the use of 60 h. p., but the company intends to use as high as 300-h. p., if business will warrant it, for which the company will pay $4 a horse power yearly. The company will build its own wheel house and put in at the start a 90-h. p. wheel. A 600 light incandescent machine will be installed at first. The company has filed the preliminary papers for the organization of the Brush Electric Company, of Ontario, the business of which will be furnishing electric light, establishing and building electric railways and the manufacture of all kinds of electrical apparatus. The plans for the buildings and machinery are now being prepared.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Sept. 7, 1892.

Electric Lighting of Dublin.—A large central station has just been erected and equipped in this important city. The plant is of two kinds, the Lowrie-Parker high tension alternating system being used for supplying current to consumers' houses and the continuous-current Brush system for the street arc lamps. The current for private lighting is supplied by three Lowrie-Parker alternators, each having an output of 75 ampères at 2,000 volts when running a 350 revolutions. Each machine is thus capable of supplying 5,600 8 c. p. lamps. These alternators are driven by means of rope gearing from three pairs of compound horizontal non-condensing engines of 280 h. p. each, running at 85 revolutions per minute and being fitted with Corliss valve gear. The arc lighting plant consists of 3 vertical compound Raworth engines of 60 h. p. and running at 220 revolutions. These furnish power to three Brush dynamos having an output of 10 ampères at 3,000 volts. The general equipment of the station is in every way most complete, and among other things I may mention that Lowrie-Hall regulators have been fitted to the alternators and Brush-Geipel regulators to the continuous current machines. The mains are all underground and 78 arcs of the Brockie-Pell type have already been installed.

City Lighting.—At the second annual general meeting of the City of London Electric Lighting Company, Sir David Salomons, the chairman, was sanguine that a dividend would be forthcoming for the ordinary shareholders within twelve months. They were very busy, and every addition to their income meant practically pure profit, since their standing expenses would remain the same, the only extra expense being the coal bill, which formed only a comparatively small portion of the cost of working. What they were looking forward to, he said, was a good London fog. Arrangements have been made so that they might receive warning by telephone beforehand if possible, when a fog was coming, and if they only had ten minutes notice, he felt sure they would be able to show that electricity was equal to the occasion. All their plant and work, whether above ground or below, was of the best quality. On June 30 there were 11,860 8 c. p. glow lamps on 6,735 yards of main, giving a lamp density of 2 lamps per yard of main. If this were to hold good throughout the whole area of street work, 190,000 lamps might be run. Their machines were only running at half load, but when they had time to connect more private lighting, and the machines were more fully loaded, their income would be greatly enhanced.

News of the Week.

THE TELEGRAPH.

Seized a Telegraph Office.—During the recent trouble at Fire Island Col. Austen, of the Thirteenth Regiment, who was stationed at Babylon, L. I., sent a message to Gov. Flower through the local Western Union office. After a delay of several hours Col. Austen found that the message was still held, whereupon he immediately seized the office in the name of the State, and the operator, under the inspiration of a corporal's guard, concluded to send the message.

THE ELECTRIC LIGHT.

Hamburg, Pa., has voted for electric illumination.

The Indiana Warp Mills, of Indianapolis, have purchased a 450-light Jenney incandescent plant.

Glenwood, Ia.—The electric lights have been turned on, and the plant is now operating with entire satisfaction.

Cadiz, O., by a large majority has voted to give the franchise for lighting its streets to the local electric light company.

Hackensack, N. J., is advertising for bids for the lighting of its streets by electricity. The present contract expires Nov. 1.

The Sumter (S. C.) Electric Light Company has decided to increase its plant.

The Kensington (Ga.) Electric Light Plant was recently almost entirely destroyed by fire.

Electric Lights Demanded.—A petition has been circulated in Harlem among the residents on Seventh avenue asking for electric lights above 110th street, and has received a great many signatures.

Whitehall, N. Y., has decided in favor of the electric light, and let the contract to T. C. McLachlin for five years for the sum of $3,700 per year.

Marble Falls, Tex., is to have a thorough system of electric lights and water works. The building is to be an iron structure 100 × 2 0 feet, and will be completed within 90 days after the construction of the flume.

The Salem Electric Company, of Salem, Va., has sold its electric light plant to the town of Salem. Its present capacity is 50 arc Thomson-Houston 1,200 c. p. and 650 alternating incandescent 16 c. p., run by a Weston engine 105 h. p. Wm. T. Younger is mayor; A. G. Duncan, chairman of the lighting committee, and Geo. C. Hill, superintendent. The city paid $19,000 for the plant.

The First Municipal Electric Light Plant in Connecticut.—The $22,500 which was appropriated by the city of South Norwalk for the construction of a municipal electric lighting system has been judiciously expended and the plant is now nearing completion. A site was selected on the south side of State street adjoining the Housatonic Railroad. The power house is a one-story fireproof structure with a 40-foot front and a depth of 66 feet. The roof is slated and has two cupolas, the one serving as a wire tower and the other as a ventilator for the boiler room. The station equipment consists of a 125-h. p. horizontal tubular boiler with feed water heater and injector, a 100-h. p. Ideal automatic high speed engine, and two Western 60-arc light dynamos. The plant is very fully equipped and will shortly be placed in operation.

THE ELECTRIC RAILWAY.

Brooklyn, N. Y.—The horse cars on the Smith street line have been replaced by electric cars, which now run down to the Fulton Ferry.

The Mount Vernon (Va.) Electric Railway Company has nearly completed the equipment of its power house and line and the road will soon be in operation.

The Hartford (Conn.) and Wethersfield Horse Railroad Company has petitioned for permission to experiment with an underground system of electric railway.

Chicago, Ill.—Work will begin immediately on the equipment of the Sixty-first and Sixty-third street lines with an electric road and it is hoped that they will be finished by December.

The Woodward Storage Battery.—For more than three weeks the Woodward storage battery has been undergoing a test at Detroit, Mich., being used to operate a car on the Jefferson avenue route. The car ran only regular time, doing the same work as other cars on the line. It is reported to have run as many as 84 miles without recharging and no accident of any sort interfered with its successful working.

PERSONALS.

Edward J. Hall, vice-president and general manager of the Bell Telephone Company, of Buffalo, N. Y., died suddenly of heart disease at his residence in Buffalo last week.

Dr. Wellington Adams, general manager of the Chicago & St. Louis Electric Railway Company, was in New York last week attending to business in connection with his high speed railway project. Dr. Adams expects to make a trip to Europe at an early date to attend to a similar line of work.

Dr. Daniel W. Shea, of Harvard University, has accepted the chair of physics at the University of Illinois. Dr. Shea received the degree of A. B. from Harvard in 1886, and returned the next year as a post-graduate. After taking the degree of A. M. in 1888 for special work in electricity he went to Berlin as the John Tyndall Fellow of Harvard University and for three years studied under Helmholtz Kundt and others. Receiving the degree of Ph. D. in physics from Berlin in May, 1892, he returned to Harvard University as Assistant Professor of Physics, a position which he now resigns to accept the chair at the University of Illinois.

MISCELLANEOUS NOTES.

The plant of the New Haven (Conn.) Insulated Wire Company has been totally destroyed by fire.

Electric Railway Statistics.—The August bulletin of the General Electric Company shows that the total number of lamps in operation and under contract using Edison and Thomson-Houston systems is 402, while the total number of cars for these roads is 8,085. The total miles of track now in operation equipped with these two systems is 4,250.

A Long Lived Lamp.—Mr. Ernest Kitson, the superintendent of the Edison Electric Illuminating Company, of Bellefonte, Pa., writes to us to say that he has an Edison 107 volt 16-c. p. lamp that was put in circuit April 1, 1881, and has been in service constantly on an average of 13½ hours a day until May 30, 1892, a total period of eight years and two months. This would give the lamp a total life of over 40,000 hours. It is stated in addition that during the last three years the voltage on the circuit has been over 110 volts.

Water Wheel Regulators.—The Pelton Water Wheel Company has sent us the following correction as an addition to the letter recently printed in our columns: "In your issue of the 27th ult., under the head of 'Turbine Regulators,' we referred to the successful working of the governors at the Roaring Fork Electric Light and Power Station in Aspen, Colo., but inadvertently neglected to mention that these regulators were the invention of Mr. C. E. Doolittle, manager of this plant, to whom full credit should be given. It may also be stated that these governors are equally applicable to turbines or any other form of wheel."

Industrial and Trade Notes.

Mr. W. H. Brown, Tallapoosa, Ga., is placing a new self-binding insulator on the market that will no doubt meet with ready sale.

Chas. D. Shain has opened offices at 303 Electrical Exchange Building, New York City, and will represent the Weston Electrical Instrument Company.

The Snow Pump Works has removed from 116 Liberty street to 106-108 Liberty street. The company's new quarters are large and very conveniently arranged.

The Laidlaw & Dunn Company, Cincinnati, O., has secured the contract for pumping machinery, including compound Duplex pumping engines, deep well steam pumps, boilers, heater, etc., for Wyoming Water-Works, Wyoming, O.

Messrs. Wirsching & Sons have received a number of orders for arc lamps of the type described in a recent number of THE ELECTRICAL WORLD. Among other orders is one for lamps for the equipment of a plant in Chicago.

Recent Engine Sales.—The firm of A. L. Ide & Son, Springfield, Ill., report through Mr. E. C. Sargent, manager of the Chicago office, sales of Ide and Ideal engines in the city of Chicago to the number of 132, having a total capacity of 11,899 h. p.

The Endolithic Ivory Company, of London, has sent us an ivory tablet bearing the company's address by the Endolithic process, rendering the lettering absolutely indelible. This process is applicable for address tablets, for speaking tubes, annunciator tubes, etc.

Chas. J. Jaeger, manufacturer of automatic mercury pumps for exhausting incandescent lamps, reports great success. He will shortly place upon the market some novelties in the way of incandescent lamps of all sizes and colors. He also manufactures lamps for scientific purposes.

The United States Projectile Company, of Brooklyn, N. Y., has placed an order with the Berlin Iron Bridge Company, of East Berlin, Conn., for an addition 240 feet long to its present building. The addition will be entirely of iron, and is from the designs of the Berlin company.

A Big Contract.—The largest single order on record for arc lighting apparatus complete was filed this week with the Standard Electric Company, of Chicago, and calls for 50 of the Standard arc lighting dynamos and 2,500 lamps and accessories. The deal was consummated by Col. F. O. Richards and general manager D. P. Perry.

Mr. I. P. Frink, of 551 Pearl street, New York, manufacturer of the well known "Frink" reflectors, has recently made installations in the following churches: M. E. Church (South), Marshall, Mo.; Presbyterian Church, Washington, Ia.; First Congregational Church, Bay Shore, L. I.; M. E. Church, Stroudsburg, Pa.: Presbyterian Church, East Stroudsburg, Pa.

The John Stevenson Car Company, 47 East Twenty-seventh street, New York City, is now working to its full capacity. It recently completed a contract for 70 grip cars, and has now on hand an order for 22 closed trailer cars. It is also building cars for electric railroads at the following places: Canton, O.; East Liverpool, O.; Houston, Tex., and Washington, D. C.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., has issued a new edition of its elaborate catalogue, which shows that a number of new machines have been added to the company's list during the year. This year the catalogue has 248 pages; last year it had 228; the year before, 205; in 1888, 175; in 1887, 155; in 1879, 100; in 1875, 66 pages.

Messrs. Murray, Whitehead & Murray, of Trenton, N. J., are doing a large business which is increasing from month to month, as is shown by the report of their sales. Their factory is now running at its full capacity, and it is probable that a large extension will be made at an early day, as their orders at the present time are large enough to tax their plant to its fullest capacity.

Mr. Arthur T. Woods, late professor of engineering at the University of Illinois, has accepted the office of associate editor of the *Railroad Gazette*, and has established his headquarters at 304 "The Rookery," Chicago. Prof. Woods is especially interested in the application of electricity to railway lines. He will also furnish his paper with some interesting letters regarding World's Fair matters.

The Joseph Dixon Crucible Company is sending out a little pamphlet giving some information upon graphite as a lubricant. In this pamphlet the company has endeavored to state clearly the value of some of the uses of pure flake graphite as a lubricant, and the reason why some experiments with ordinary commercial graphite have resulted in such poor success. The pamphlet contains the opinion of Prof. R. H. Thurston, with a brief summary of tests made by him to ascertain the lubricating of graphite.

Dr. Robert Dickinson, chief engineer of the Hamilton (Can.) Electric Light and Power Company, was in New York the past week in the interest of the above named company. While here he purchased of Hine & Robertson, 45 Cortlandt street, one of their famous straight line indicators as mate to one purchased by the company some time since. Mr. Dickinson has lectured on the subject of indicators in this country and abroad and is highly enthusiastic of those made by Messrs. Hine & Robertson. Such a testimonial is indeed flattering to them.

The General Electric Company has made a contract with the Merrimac Valley Street Railway Company, Lawrence, Mass., by which the railway company substitutes in the place of motors formerly in use 15 car equipments of two motors each of the "S. R. G. 30" type. The General Electric Company has also made a contract with the Cass Avenue Street Railway Company, of St. Louis, Mo., for 85 car equipments. The cars are to be equipped with two 25-h. p. motors each of the "w. p." type. The power plant will consist of three 800-h. p. direct coupled dynamos.

The Columbia Incandescent Lamp Company, of St. Louis, seems to be doing a prosperous business in the manufacture of incandescent lamps. The sales reported for the past week have largely exceeded 20,000 lamps, which is considered a good showing for this season of the year. A user of Columbia lamps in a letter to the company made this statement: "I have had considerable experience in the use of different makes of lamps, having noted the life of each and the current consumed, and I consider the Columbia one of the best, if not the best, on the market."

Smith & Vaille, of Dayton, O., through J. M. Duncan, the New York agent, at 110 Liberty street, have been very successful in placing orders for their pumps in the electrical and kindred interests in the East. Among their sales were those at the following points: Brooklyn; Little Falls, N. Y.; Wayland, N. Y.; Bloomington, Ind.; Sheldon, Iowa; Trenton, N. J., and Boston. The Brooklyn orders were from the Brooklyn City Railroad Company, two one million gallon, each duplex; Edison Company's New Station, two one million gallon, each duplex. At the factory of the Smith & Vaille Company it has become necessary to work night and day to fill orders.

The new catalogue of the Clayton air compressors is very complete, and describes in detail the various styles of steam and belt actuated air compressors for use in mining, tunneling, railway and bridge building, pumping natural gas, supplying pneumatic tubes, operating pneumatic riveters, tools and cranes, aerating water, elevating water, acids and other liquids, submarine works; operating oil fuel burners, refrigerating and ventilating, charging automatic sprinkler systems, stripping rubber hose in rubber factories, testing tinware, etc. It also illustrates and describes the new high pressure compressor, as manufactured by the Clayton Air Compressor Works, of 43 Dey street, New York City.

The Belknap Motor Company, of Portland, Me., which was incorporated on Nov. 3, 1890, has attained a very rapid development in the two years of its existence. Its incorporators and stockholders include many of the leading business men of Portland. The manufacturing part of the business up to a recent date has been by contract, but the growth of the business has been such that the establishment of a factory became a necessity. A fine building in a favorable location was secured, and this has been fully equipped with the necessary machinery, combining all the modern improvements. The company was incorporated for the purpose of manufacturing water motors, electric motors, dynamos, power coffee mills, etc., and these products have been shipped to nearly every State in the Union as well as to foreign countries, including Australia, Italy and Mexico. The new style of electric motor and dynamo constructed by this company is known as the B. C. standard, and is a well designed and perfect running machine. Among the practical business men of Portland using these motors are J. P. Baxter, W. W. Whipple & Co., J. B. Curtis, R. H. Davis & Co., Owen & Strout, Evans & Richard, the managers of the steamer "Cornelia H," and the Consolidated Electric Light Company. The largest locomotive and boiler works in Maine has just placed its order with this company for a 40-h. p. generator to furnish current for operating its new electric crane.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Transformers re-wound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Every One Interested in Electricity Should Have It.—Mr. A. T. Best, electrical engineer, St. Augustine, Fla., states the following regarding "Houston's Dictionary of Electrical Words, Terms and Phrases": "I am very much pleased with my copy of Houston's Dictionary and I recommend every one interested in the electrical business to secure a copy."

Houston's "Dictionary of Electrical Words, Terms and Phrases."—Of the second edition of this work the *Electrical Review*, of London, says: "Those who have copies of, or who recollect, the first edition of this work, will be much struck by the great advance in every way which is marked in the present edition. Speaking, generally, it may be said that the size of the book has been doubled, the number of definitions being about twice as great as was the case in the original work. There are many to whom the new edition will be welcome; not only will students and members of the rising generation have their studies in electrical science made easier and clearer by frequent references to the pages, but many of the older school, whose work has so long been in one groove that they experience a difficulty in grasping what to them are new fangled terms, will be glad to be enabled to keep up to, if not in advance of, the times by frequent dips into Prof. Houston's excellent production."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

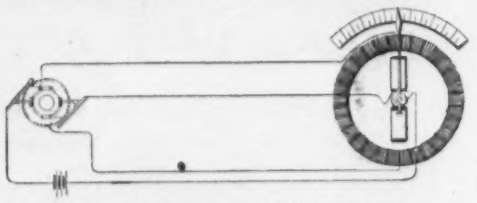
U. S. PATENTS ISSUED SEPT. 13, 1892.

482,339. Electric Light Fixture; Edwin R. Crolius, Chicago, Ill. Application filed Jan. 4, 1892. In a joint for an electric light fixture, the combination of two open-ended tubular part adapted to fit snugly together end to end with removable caps adapted to cover the ends, two pipes removably secured, one to each of such tubular parts and through the caps parallel with the length of the tubular parts and adapted to hold them securely together.

482,343. Inclosed Conductor for Electric Railways; George A Dupuis, Detroit, Mich. Application filed May 16, 1891. The combination of an insulated electrical conducting wire, conducting piston rods or plungers reaching through the insulation of the electrical conductor, friction rollers on the outer end of the plungers moving with them, fixed friction rollers opposite the first mentioned friction rollers, and a contact making traveler arranged to travel between the friction rollers, and of a thickness sufficient to force the rollers apart and the piston into contact with the main conductor.

482,374. Automatic Electric Cut-Out; Cyprien O. Mailloux, New York. Application filed Sept. 9, 1890. The combination with a switch, of a catch or detent therefor, an armature adapted to engage the catch in its forward movement toward the pole of the magnet, and an adjustable stop upon the catch for determining its position with relation to the armature.

482,397. Ventilating Armature for Dynamo-Electric Machines; Elihu Thomson, Lynn, Mass. Application filed April 2, 1885. The combination with a hollow armature, of tubular extensions encircling the armature shaft at opposite ends of the armature, a box or casing in which the end of one extension revolves, a pipe connected with the box, and a blower.



No. 482,421.—Rudder Indicator.

482,420. Adjustable Thermostat; Melvin D. Compton, Newark, N. J. Application filed Nov. 21, 1891. In a thermostat, an adjustable frame or plate carrying insulated posts, a pair of electromagnets, one on each post, these electromagnets being adjustable with reference to the posts, all in combination with a thermostatic piece having or carrying an armature between the electromagnets.

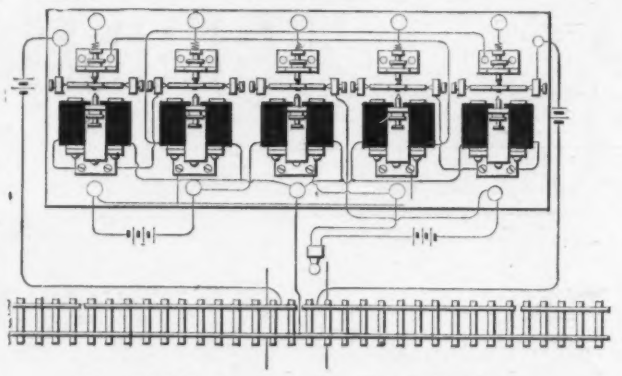
482,421. Rudder Indicator; Charles Cory, New York. Application filed Nov. 24, 1891. In a rudder indicator, two series of commutator bars and brushes, each brush moved upon its commutator by the turning of the rudder and arranged one series to control the positive and the other the negative current, in combination with each other and with a source of electric current, electrical connections connecting each commutator bar to the indicating mechanism having an electromagnet controlled by such current, all arranged for joint operation. (See illustration.)

482,422. Railway Crossing Protector; Robert J. M. Danley, Columbus, O. Application filed March 2, 1892. A single-track railway signal consisting of the combination of an alarm or gate, two sets of relays respectively operating the alarm or gate for trains coming in both directions, and two other relays controlling the two sets of relays respectively, to make them inoperative when a train has passed the alarm or gate. (See illustration.)

482,423. Railway Crossing Protector; Robert J. M. Danley, Columbus, O. Application filed April 20, 1892. The combination, with an alarm or gate for highway crossings of railroads, of a relay operating the alarm or gate, two other relays, each controlling the first relay, and still two other relays, each controlling the other and the alarm relay, and two insulated sections of track in circuit, respectively, with the two relays controlling the first relay, and batteries connected between the rails, whereby the wheels and axles of trains will operate an alarm or gate.

482,425. Galvanic Battery; Thomas T. Eckert, New York. Application filed May 16, 1892. In a galvanic battery, a zinc electrode formed of zinc plates having screw-perforations and separate zinc screws alternately arranged and applied, and a cross-bar to which the electrode is suspended by one of the screws. (See illustration.)

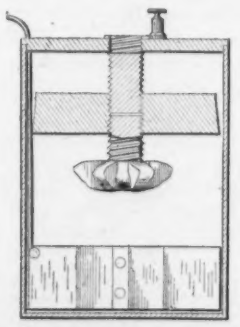
482,433. Safety Device for Electric Circuits; Llewelyn B. Atkinson, London, England. Application filed Sept. 12, 1891. A compound electric conductor consisting of a main conductor of stranded wires taking the longitudinal tension of the cable and containing a protected automatic cut-out in its circuit, in combination with the subsidiary closely coiled conductor of single or multiple parallel wires adapted to readily extend its coils under longitudinal tension without breaking, connected as a long shunt to the main conductor and having a protected fuse in its circuit and surrounding or surrounded by and insulated from the main conductor.



No. 482,422.—Railway Crossing Protector.

482,435. Electric Arc Lamp; Henry H. Cutler, Waltham, Mass. Application filed June 25, 1891. The combination of the feed pawl and its actuating pawl carrier with a pawl controller governing the engagement of the pawl and a regulator responsive to change in length of the arc as operating with the pawl controller.

482,440. Telegraph Relay; William Maver, Jr., New York. Application filed July 18, 1891. In a telegraph system, the combination of a main line conductor, relatively movable coils in series with each other and in circuit with the main line conductor, two portions of each coil being at an angle to two portions of the other and the remaining portions of each coil being parallel to one another, an independent or local line conductor, and a circuit closer in circuit therewith and controlled by the movable coil. (See illustration.)



No. 482,425.—Galvanic Battery.

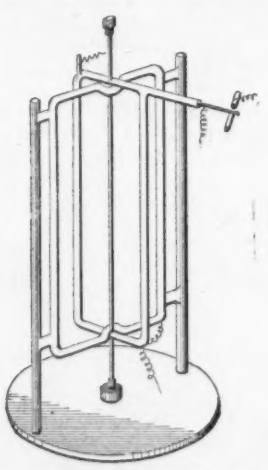
482,444. Voltaic Pile; William E. Washburn, Cedar Rapids, Ia. Application filed June 14, 1892. In a voltaic pile, the combination of positive and negative elements in alternating series, interposed absorbents and non-conductors also in alternating series, with contact points to connect the elements separated by the non-conductors, and an insulated stem passing through the entire series and having an electrical connection with one of the elements at one end, and means for closing the circuit.

482,464. Burglar Alarm; Homer T. Wilson, Louisville, Ky. Application filed March 4, 1892. This device is adapted to be used in connection with a projection on the lower rail of a window sash, or other object, consisting of an inner and outer spring contact plate provided with aligned perforations near one end, an insulating block interposed between the plates and provided with aligning perforations and at opposite sides with wire-receiving grooves, and screws passed through the aligned perforations of the plates and intermediate insulating block and adapted to project beyond the same into a window sill or other object and to clamp the plates, block and wires, the plates having their ends beyond the block bent and adapted to contact.

482,486. Line Wire Tightening Device for Electric Lamp Supports; Charles A. Pfluger, Chicago, Ill. Application filed May 3, 1892. In combination with a suspension-support for an electric lamp, a rotary binding post having a winding drum provided with an attaching device for the line wire, and means for holding the post against the strain of the tightened line wire.

482,506. Underground Trolley; Joseph Fischer, Cleveland, O. Application filed March 5, 1892. In an underground trolley system, the combination of a conduit, insulators, supports, an electric conductor, a trolley arm, a trolley wheel, a shield, an anti-friction sleeve and depending clearers.

482,535. Clamp for Arc Lamp Carbons; August Weber, Schenectady, N. Y. Application filed Nov. 4, 1891. The combination, in a carbon holder, of the main body, and the extension therefrom, a link the lower end of which is pivoted to the extension, a clamping jaw pivoted to the upper end of the link, and means for pressing the jaw against a carbon in the clamp.



No. 482,440.—Telegraph Relay.

482,549. Means for Controlling Electric Generation; Thomas A. Edison, Menlo Park, N. J. Application filed March 12, 1881. The combination, with a main or consumption circuit, of one or more magneto-electric machines connected therewith, an exciting machine supplying the field circuit of the main machine or machines, means for varying the speed of the exciting machine independently of the main machine or machines, and a suitable electrical indicator indicating the condition of the main circuit.

482,568. Electric Arc Lamp; Hubert H. Bigland and John Burns, Newcastle-on-Tyne, England. Application filed April 20, 1892. An arc lamp having a twist rod, a movable carbon holder controlled thereby, means for lifting the twist rod and holder simultaneously, and means for imparting a rotary motion to the twist rod at a determinate point of its lift.

482,594. Electric Locomotive; William H. Soley and William Washington Perkins, Philadelphia, Pa. Application filed Jan. 7, 1892. In combination, a truck, motor, driving connections therefrom to front and rear axles respectively, clutches and idler connections between the axles, comprising the shaft and miter gears, the shaft being in connection with the motor frame.

482,668. Electrical Apparatus; Leonidas G. Wooley, Grand Rapids, Mich. Application filed June 6, 1892. An electrical apparatus comprising a coil or helix, two circuits, a vibrating rheotome within both circuits, a shifting bar carrying a contact point which is within both circuits, the contact point engaging the rheotome, the shifting bar limiting the upward movement of the rheotome and itself moving substantially at right angles to the rheotome, and electrodes connected to the coil or helix.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.